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ABSTRACT

This collection of 10 papers from the 1981 conference of the Interuniversity Communications Council (EDUCOM) highlights developments in new communications technologies and their impact on higher education, emphasizing computer usage and telecommunications advancements. Three papers analyzing computer applications to higher education focus on the role of higher education institutions in developing computer literacy (Arthur Luehrmann); the Decision Information Display System (DIDS), a computer-driven, rapid, interactive system for color mapping of statistics, which is designed to aid decision-making (Curtis L. Fritz); and an experimental implementation of a computer system in a political science office, which suggests implications for the office of the future (G. R. Boynton). Primarily concerned with telecommunications and video technology, the next four papers provide a tutorial on videodisc technology (Joan M. Sustik) a review of telecommunications technology (Robert Gaynor), a summary of instructional telecommunications in Alaska (Jane P. Demmert), and a discussion of the implications of television technology advances for higher education (John Blessington). The remaining papers address national and international policy issues related to higher education (Irving Shain), the implications of high technology for administrators (Joseph Lipson), and information systems control and security (Joel B. Urman). (LMN)

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SELECTED PAPERS OF THE

EDUCOM ANNUAL CONFERENCE

November 1981

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"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Computer Literacy

by Arthur Luehrmann

Arthur Luehrmann is co-founder and a principal in Computer Literacy, located in Berkeley, California. He is currently working on a computer literacy curriculum for elementary and secondary school students under contract with McGraw-Hill, Inc. Prior to founding Computer Literacy, Dr. Luehrmann was Associate Director for Computing Activities at Lawrence Hall of Science, a museum and community resource center affiliated with the University of California, Berkeley. Previously, he was a faculty member in the Physics Department and an Assistant Director of the Kiewit Computation Center at Dartmouth College. Dr. Luehrmann earned his Ph.D. in Physics at the University of Chicago.

Any discussion of computer literacy in higher education must take into account current events in computing in elementary and secondary schools insofar as the students in these schools still provide the bulk of entering students for colleges and universities. Despite a general reduction in the number of individuals aged 18 to 21, the proportion of individuals in this age group attending colleges and universities is rising. Consequently, high school graduates entering college directly will continue to constitute a major portion of undergraduate enrollment.

Looking more closely into the background that an entering freshman brings to a college or university, I present in the following paragraphs several forecasts based on observations of the computing situation in elementary and secondary institutions. What follows is a discussion of the implications of those conclusions for colleges and universities.

The Three-Year Forecast

Within three years, the average secondary school will have a computer laboratory or classroom with approximately 16 computers. This conclusion is drawn from the following data: the number of computers in secondary schools is growing at an annual rate of 60%; at present there are about 100,000 computers in grades 7 to 12; at the end of three years, we should therefore see 400,000 computers in junior high and high schools. This figure is roughly equivalent to 16 computers per school. Within that same three-year period, 50,000 secondary school teachers will be teaching computing as their main subject. Unfortunately, few will have had any training to prepare them for this task other than on-the-job experience, self-study or attendance at commercially run professional development courses. A few may have the opportunity to take a course in computer science or a specific programming language at a nearby college or university.

Also within three years, the majority of college entrants will have had at least a one-semester laboratory course in computing. This conclusion follows from the expectation that 50,000 high school teachers will be teaching computing as their main subject. If there is only one teacher and one computer lab in each of the 25,000 high schools in the United States, the majority of college entrants can be expected to have had at least 50 hours of hands-on experience, to have written simple programs and to be familiar with one or two programming languages.

The Five-Year Forecast

Within five years, a substantial number of college entrants will have completed a two-semester "advanced placement computer science course" equivalent to the better introductory computer science courses now offered at universities. These students will know two computer programming languages and be skilled at structured programming, modular design of systems and top-down planning. They will know many algorithms and data structures. Their knowledge will effectively make obsolete many of the introductory computer science courses currently in place in colleges and universities.

In addition, the majority of college entrants will be experienced in the use of word processing software as a routine aid to writing. Word processing software might be resident on a micro, mini or mainframe, and might be available to them personally or through their high schools. They will expect similar tools to be available in the colleges of their choice.

Implications for Colleges and Universities

The most immediate implication of these changes will be an imbalance in supply and demand for computing evident in the attitude of entering college students. "Where are the computers?" they will ask. "I had better access to computers in high school." Colleges will be faced with the necessity of offering access to computing services and being unable to do so. Poor access will be a primary issue. Computer science courses will undoubtedly be overcrowded as high school students seek advanced training in computer applications only to find traditional computer science courses in the curriculum. Since

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other faculty will likely not be ready to put computer applications into their courses, computer science departments will experience even greater pressure to produce virtually all the computer training offered in colleges. In summary, colleges and universities will face three problems almost immediately:

- poor access to computing
- overcrowded computer science courses
- unprepared general faculty

Few colleges or universities can meet the demand for access to computers merely by increasing the size of present facilities. The five-year cost of even modest time-sharing systems, including staff, comes to $10,000 to $20,000 per terminal. Thus the "microcomputer laboratory" gives the only evident solution to the problem. A local network of micros, including a hard disc server, one or two printers and a student supervisor costs about one-third as much as most timesharing systems.

Several colleges and universities are using just this type of microcomputer lab for their introductory Pascal-based computer science courses, and students, faculty and administrators seem pleased with initial results. Students like the microcomputer lab because the system never goes "down," and the response time does not depend on user load. Faculty like it because they have more control of the facilities they need for instruction. Administrators like it because its costs are low and easy to understand and forecast.

The only source of opposition is some campus computer centers, which stand to loose control of instructional computing funds and of campus leadership in computer policy matters. Such opposition is bound to appear self-serving, and often it is. But the micro labs will happen, with or without computer center opposition. Extramural funding or administrative fiat will see to that. Without leadership and planning, however, departmental decisions will lead to a babel of computer languages, systems and programming environments. Rather than acting the monopolist, the computer center director should be leading the way towards a rational, integrated system of loosely coupled microcomputer labs.

With the range of teacher preparation and the plethora of self-taught high school computing teachers, entering college students will arrive with an incredible variety of preparation in computing. College and university faculties will then face two immediate tasks. First, they will have to determine the student's level of knowledge, and second, they will have to offer a variety of computing courses. Because tests will most likely be necessary to find out what students know, college faculty members or test developers will have to construct innovative testing instruments within the next few years. A variety of courses will then have to be offered to meet the identified needs of students.

At least three primary types of courses will be needed:

- Bonehead Computing
- Orthodonture courses
- Honors Computer Science

"Bonehead Computing" will be required for individuals who come from high schools in which the computer has not yet appeared or in which the computing teacher was insufficiently prepared to provide more than a general acquaintance with some of the jargon associated with computing. Bonehead Computing will replace current introductory courses in computing now offered in colleges and universities.

"Within three years, the average secondary school will have a computer laboratory or classroom with approximately 16 computers."

Again reflecting the diversity of preparation of computing teachers in high schools, many students will enter college with a zealous enthusiasm for computing but with no knowledge of structured programming, modular design and other aids to preparing efficient programs that can be understood and used by others. For these individuals, the appropriate "Orthodonture" computing courses will correct bad habits, introduce them to methods of documentation and train them to organize their programming. In general, Orthodonture courses will fill in the gaps left by high school computing education.

Finally, honors courses in computer science will have to be available for those high school graduates who have completed several courses in computing and who have already achieved the level of proficiency required of freshman and sophomore computing students today. These students will likely enter college having passed the advanced placement test in computer science currently being designed for the College Entrance Examination Board.

Subsequently, to fill these needs for more computing courses, additional university faculty will be needed. Unfortunately, the demand for specialized faculty comes at a time when industry is competing with colleges and universities for computer science faculty "and winning." Our institutions will have to be creative to retain faculty and staff who are capable of teaching computer science courses ranging from Bonehead Computing through Orthodonture courses to Honors Computer Science. Perhaps the best course of "computing" faculty is the large number of existing faculty members in a variety of disciplines. With appropriate professional development courses, workshops, etc., liberal arts faculty can and should apply and teach computing concepts in a wide variety of courses. Some faculty members, who delve deeply into computing applications, can certainly also choose to acquire specific training in computer science to enable them to share in the responsibility for these new computing needs.

Implications for Colleges of Education

Schools of education within our colleges and universities will feel the impact of changes in high school computing instruction most directly. For most colleges of education, the impact of computing can be viewed as an opportunity rather than a threat. Colleges of education will have the opportunity to train the 50 to 100,000 teachers in colleges and universities who, during the next three to five years, will be taking on the responsibility of training high school students in computing. What better source of rejuvenation is there for colleges of education currently feeling demoralized by a drop in demand for teachers caused by a shrinking school age population than to provide in-service training for hundreds, if not thousands, of teachers who will be taking on this challenging assignment? What better economic opportunity for the colleges of education than to provide in-service training on which full cost can be recovered?

Of course, training new teachers appropriately is also a continuing challenge for colleges of education. Immediately, training in computing for education students can be combined with in-service training for practicing teachers.

(continued on page 24)

(continued from page 15)

In the long run, however, colleges of education will face the same problem as do liberal arts colleges. How do current faculty acquire enough expertise in computing to effectively train entering students? Here again, the colleges of education that undertake in-service teacher training have an advantage. The basic in-service program for secondary school teachers can be custom-tailored for internal college of education faculty.

In addition, some of the in-service training offered to secondary school teachers may be adapted and used with existing liberal arts faculty in order to bring computer applications into general instruction at the university level. Although "in-service training" for liberal arts faculty will be a new task for most colleges of education, it may be the best source of professional development in computing within a university.

Finally, new curricular materials will have to be developed for traditional subjects at the university level, and new interdisciplinary topics that benefit from the availability of computing power will most likely arise. The discipline-oriented faculty who teach these courses will probably seek some training to feel comfortable with computing applications in their courses. At a minimum, they will need to know how entering students have become familiar with the computer as a tool in secondary schools.

Implications for Society

In addition to the impact on colleges and universities, the rising level of computer literacy among entering college students and among individuals of all ages has implications for society as a whole. As the power of computers increases, citizens with information skills become more and more advantaged relative to those without information skills. The "brain workers" of our society will become increasingly more advantaged while the "brawn workers" or the unemployed become less and less advantaged. The resulting disparity in social class will be great. We will have to acknowledge and deal with this disparity if we are to profit from the development of technology during the next few years. It is the duty of free public education to provide equality of opportunity. Sadly, few in public education are doing anything to address the issue of providing critical information technology skills to all U.S. citizens.

(Kind thanks to Carolyn Landis, whose excellent editorial orthodonture straightened the teeth and filled the gaps of this paper.)

The

DECISION INFORMATION DISPLAY SYSTEM (DIDS)

As Submitted to

The Urban and Regional Information Systems Association

And as Awarded

EXEMPLARY SYSTEM IN GOVERNMENT

And Presented At The

EDUCOM ANNUAL CONFERENCE

Kansas City,Mo

November, 1981

by

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THE DECISION INFORMATION DISPLAY SYSTEM (DIDS)

by

Curtis L. Fritz

1.0 Context and Scope

In the world of information systems, the relationship of the user to the data has four aspects: speed; specificity; surrogates; and synthesis.

In the classic scene, the user walks to the library...talks with the librarian, who searches the catalog (surrogate)...to see a reference about a book which may (specificity) contain information which, when delivered, the user can search to find, retrieve, and copy a bit of information or relatively relevant fact. After several iterations, the user assembles the pieces and generates (synthesizes) a conclusion, generality, or hypothesis.

In the modern scene, the user sits down at a work station, flips a switch... scans a menu...selects the option...views a nearly instantaneous spatial representation of the retrieved data set(s)...manipulates the class, scale, color of the image...and concludes the nature and extent of relationships or phenomena reflected by the data...and decides his course of action. He may, or may not check for the source and validity of the data.

To insist that all the same elements are present in both scenes is like insisting that the computer just adds fast.

2.0 DIDS - an Exemplary System

The "latest" in information systems is computer graphics. This technology enables the output of retrieved numeric data to be presented in chart format (trend line, bargraph stacked bars, pie, exploded pie, etc.) in contrast to list or tabular format. This technology is rapidly becoming the boom sector of the information industry...not only the big hardware manufacturers (IBM, DEC, etc) and the specialty firms (Tektronix, Ramtek, etc.), but now the information vendors are joining the trend in their offerings. A special case of computer graphics is computer mapping of retrieved numeric data. The use of mapping to present data is not new to cartography, urban, and regional planners. Even computer mapping using x-y plotters is not new. What's new is fast, interactive, color mapping of statistics. A premier case is the Decision Information Display System (DIDS).

The Decision Information Display System was derived from a custom-made image analysis system developed at the Goddard Space Flight Center under the auspices of the technology transfer program of the National Aeronautics and Space Administration, the Bureau of the Census, and others under the leadership of the Office of Federal Statistical Policy and Standards (OFSPS), the Congress, and the White House.

The Decision Information Display System is a computer-driven choropleth themetic mapping system designed to aid decisionmaking.

2.1 Background

The Decision Information Display System (DIDS) is the product of an interagency developmental program. The program's purpose is two-fold: 1) to aid national issues analysis and policy formulation at the national level; and 2) to facilitate and improve the effectiveness of access by all sectors to the rich Federal statistical data base. Program management is in the Office of Federal Statistical Policy and Standards (OFSPS), which is responsible for statistical policy and coordination of the Federal statistical community. DIDS program coordination is by a Steering Committee comprised of representatives of the 26 participating and funding agencies, involving both the Executive and Legislative Branches.

After an initial demonstration at the White House and the Capitol Building, the agencies launched a 1-year demonstration and experimentation program which successfully demonstrated the system's potential for the stated design purposes. A second year of cooperative efforts has resulted in a full-time dedicated operational hardware and software system, including a pilot remote terminal system with a limited stand-alone capability. A third year of cooperation is underway for the further development and operational use by the agencies, and outreach to all sectors.

2.2 What It's Made Of

The physical system consists of a half-megabyte minicomputer (VAX 11/780) with three large disc drives (176 Mb each), 2 tape drives, a special raster-graphics terminal device driver, a CRT alpha/numeric terminal and a high-resolution (512x512 pixels) color TV monitor. The system is programmed in Fortran IV (mostly) and assembly language. Hard-copy image output is by a video camera system hard-wired to the terminal device driver.

There is also a Remote Terminal System (RTS) which consists of an LSI processor (PDP 11/23) of 128 K words, three disc drives with removable disc packs (5.2 Mb each), the special DIDS terminal device driver, an alpha/numeric CRT terminal, a high-resolution color TV monitor, and a data link to the host minicomputer, for data exchange.

2.3 What's In It

The present demonstration data base consists of over 5,000 data element files from 20 Federal statistical agencies. Subject matter includes demographic, social, economic, business, natural resource, health, and environmental data.

The cartographic data base consists of digitized boundary maps derived from the Bureau of the Census DIME and Metropolitan Map Series, and from the CIA World Data Bank I.

2.4 What It Does

The system displays statistical data sets in a multicolor cholorpleth map format. It groups the geographic areal entities into five data classes based on their value for the selected attribute variable. Each of the areal units (i.e., county, tract, etc.) is colored according to the assigned color for its data class, and the whole map is brought up on the color screen in a matter of a few seconds after selection of the attribute variable.

The system displays: The United States by State; the United States by county; the United States by congressional district; an individual State by county; individual standard metropolitan statistical areas (SMSA's) by census tract; or the world by country.

2.5 How It Works

The system has been designed to be very "user-friendly," enabling nontechnical personnel to operate the system without having to learn a new language. It has accomplished this by using the "menu" technique.

The user sits down at the alpha/numeric CRT terminal and is given interactive instructions for a simple long-on. After logging on, the user is presented with a succession of menus from which he selects by-the-number, and is sequentially presented with the next set of options.

The first menu is geography. The user selects either the U. S. map by county, an individual State, city, etc. The user then selects the function desired, e.g., display a single variable, or a bi-variate display (for correlation between two variables), or the computation and display of a new variable (from two or more variables in file), or create a time series image loop, etc.

The user then selects the attribute variable(s) through a succession of source and subject menus and submenus until he finally selects the specific variable(s) he wishes to examine, e.g., the unemployment rate in June 1980. In just about 4 seconds, the user is presented with a map of the United States on the color TV monitor showing, for example, all of the 3041 counties. The whole process is a matter of a minute.

Rather than an alphabetical listing of the 3041 counties, the user is presented with a picture, a geographic image showing the counties colored according to one of five data classes into which the county's unemployment rate falls. The viewer thereby perceives a pattern of the unemployment problem across the nation, region, or city. That is the design objective of DIDS—not to retrieve a specific data value, but to convey the sense of a whole data set—quickly.

2.6 User Options

Once the system has created a geographic image, the user has a menu of options for interactively manipulating the image: change data classes in number (from two to nine classes); or change the basis for the frequency distribution among the classes (equal occurrence, equal value range, nested means, standard deviation from the mean, etc.). The user can change the color for any or all data classes from a 64-color pallet. The result is a different output—in seconds!

The user can view sub-areas of the data map image by a "zooming" technique. Those geographic areas (e.g., counties) falling in a data class, or within any specified data range, can be retrieved and displayed on the alpha/numeric terminal in a listing in ascending order of the data variable value (e.g., unemployment rate). The user has thereby changed or modified the request and has obtained (created?) a different information product. The user can request and view a full-screen histogram for the data set, in seconds--and can change the numeric scale and format of the histogram in seconds--or the scatterplot of two variables.

2.7 Other Capabilities

Other system capabilities and features are exercised on-line in response to user suggestions and requests. Presently, the user can exercise the following features:

- Compute and display a new variable file by arithmetic operation on two variables from any one or different agencies. For example, derive the percapita allocation of Federal funds for each of the 3041 counties, or determine the percentage gain or loss in unemployment rates for all counties between May and June 1980.

- Composite index-variable construction, and displays equal or weighted, for any number of variables in the interagency data base.

- Bivariate display of any two variables for the same geographic base. For example, education levels achieved versus income levels on the U. S. map by counties; or ischemic heart disease mortality rates versus water hardness.

- Display bivariate scatterplot with user-variable scale ranges.

- Identify a geographic unit and retrieve basic descriptive data about that unit.

- List geographic entities falling within any specified range of the data variable, in ascending order of the variable value.

- Time-series image loop with user-controlled image change speed of two or more retrieved data files.

- Photographic copy of color screen images.

- Hard-copy listing of alpha/numeric screen data.

3.0 Future Developments

The agencies are continuing their joint efforts. Additional agencies are joining the program. The general objectives remain the same—except to move beyond demonstration of potential, and the initial operating capabilities and benefits, by further actual employment in the decisionmaking and program management processes. The near-term program objectives are:

- To develop an operational data base which contains the Federal data, including the 1980 decennial census, which are of priority interest to the participating agencies for national policy formulation and program management, and to provide on-line documentation for each data element as to its source, method of collection, confidence factors, definitions, etc.

- Increased operational utilization by the participating agencies.

- Development of a network of the agencies for data interchange.

- Extend program participation to additional Federal agencies in both the Executive and Legislative branches, and to other sectors on a demonstration project basis—especially to State, city, local, and regional government levels.

- Increased system capabilities in all categories: cartographic bases, non-map graphic displays, statistical anaylsis, alternative configurations (e.g., lower performance and cost), alternative hard-copy output, additional data, etc.

Pricrity will also be given to establishing appropriate roles for all sectors. Toward this end, the possibility will be explored for the establishemtn of a facility to be operated by private industry to provide DIDS services to all sectors on a self-supporting basis.

Demonstration projects are in various stages of development at State (South Carolina), city (with the U. S. Conference of Mayors), County (Oakland County, Michigan), and regional (Upper Great Lakes) government levels, in addition to universities (e.g., South Carolina University, Alabama University, Arizona University, etc.).

4.0 Conclusion

The ultimate impact of DIDS on the decisionmaking process is not easily predictable. It represents a new dimension of analysis by enabling the introduction of the "where" or locational aspect of the "what" situation, problem, or phenomena. Its short-term influence at all levels and sectors is more discernable.

The Decision Information Display System is a landmark to be referenced by a plethora of variations and evolvements—just on the horizon.

The Future is Now -- Sort Of

G. R. Boynton

The office of the future is defined. Pick up any airline flight magazine. Read any reasonably popular computing magazine. Or read EDUCOM Bulletin. A single vision is universal. The vision includes:

> a "work station" which is dominated by a desk top computer with disk storage for each person;
>
> a high speed communication system which provides access to greater computing power, larger disks, many different types of printing devices, and electronic mail;
>
> and a coherent system of software that permits the user to move easily between the different tasks in which he or she is engaged without having to worry about hardware configurations or how to get from one program to another.

We are a rather long way from this vision of the office of the future at this point. The equipment needed is expensive. The communication devices needed are just off the drawing board, and they are expensive. The coherent software does not exist.

I would like to describe one installation which approximates this vision of the office of the future to show what is possible with current technology at a reasonable cost. Computing at universities will go in a number of directions in pursuit of increased computing power during the next decade. The direction described here is one which is centrally motivated by getting as close to the office of the future as possible as quickly as possible.

In order to understand the context within which the installation that will be described is operating it is necessary to describe briefly the central computing resources provided by Weeg Computing Center at the University of Iowa. Weeg Computing Center provides a number of computers for academic computing. There is an I.B.M. 370, 5 Prime 750s, 4 Hewlett Packard 2000s, a Vax, and probably other computers I do not know about. There are 750

terminals on campus which communicate with any of the computers listed above through a Gandalf communication system. All of the computers listed above can communicate with each other. The context is a large mainframe used primarily for batch processing and a number of interactive mini computers. All of these computers are accessed through a communication system supporting a large number of terminals.

The department of political science, with the assistance of the staff of Weeg Computing Center, convinced the administration that it would be worthwhile to experiment with the micro computerization of an entire department. Both the seriousness of the department's commitment and our faith in the outcome was witnessed in our willingness to give up a secretarial position in return for funds to purchase a large number of desk top computers. The administration was convinced, and just barely enough money was made available for the experiment.

The department of political science is twenty faculty members and (now) three secretaries. In addition, an ancillary organization, the Laboratory for Political Research, has a professional staff of 5. And the department operates a terminal facility which had 6 cathode ray tube terminals and 2 hard copy terminals. One-half of the people involved were regular computer users. The other half, including all the secretaries, had no experience with computers.

The first step was taken in justifying the purchase; the goals of the installation had to be clearly articulated. The goals were three:

> The desk top computers purchased had to be able to operate effectively as terminals running at 2400 bits per second which is the standard speed for terminals at Iowa.
>
> Word processing had to be implemented on the desk top computers, and letter quality printing had to be done by the secretaries in the departmental office. Writing had to be at least as efficient as with typewriters and manuscript typists.

Intra-departmental communication had to flow electronically; no more hot ditto machine.

Anything else, and we expect much more in the long run, will be frosting on the cake of these three basic functions. And all of this had to be accomplished with a system of programs that naive users could learn easily. A collection of hardware is of little value if the learning required to use it is viewed as insuperable by potential users.

Once funds were in hand the equipment was purchased. A request for bids was sent out, and the best bid was for Commodore CBM 8032s. These desk top computers had two advantages. First, they were equipped with an 80 character wide screen making them consistent with normal terminal operation. Second, they were cheap. The Commodore policy of giving one computer to educational institutions for every two computers purchased reduced the cost to approximately $800. That was all the money we had for computers, but it let us purchase 32. In addition to the CBM 8032s communication facilities had to be installed which included a line into each office and a modem. And two NEC Spinwriters were purchased. This was the equipment purchased.

Purchasing the equipment was only the beginning. The CBM 8032s are computers. They are not terminals nor was the commercially available equipment and programs for converting these computers into terminals satisfactory. It would not perform reliably at 2400 bits per second. There are no disks for the CBM 8032s. We could not afford 32 disks. So the plan was to use the disk of one of the Primes as the disk for each of the 8032s. But we had no text editing program that would send its files to the Prime, and there was no way to send files to the Spinwriters for printing. With the exception of a board to produce a serial signal from the CBM 8032s these were all software problems. The "coherent system" had to be designed and the code written.

A board which would convert the internal signal of the 8032s into a signal that could be transmitted through the Gandalf communication system was designed and built by an electronics shop at the University of Iowa. A machine language program was written for the 8032s which permits them to operate in a straightforward terminal mode and which also handles communication between the 8032s and the Prime. A program was written to run on the Prime which would handle disk operations and electronic mail. A word processing program which is commercially available was modified so that it could send and receive files through these communication programs either to the Prime disk or to be printed. And a formatting and printing program to send files to be printed on the NEC Spinwriters was written. It was a large order, but most of the work was done by two programmers, neither of whom worked full time on the project, while I served as the principal program tester.

With this collection of equipment and programs it is possible to:

Use the CBM 8032s as terminals for accessing any of the University's computers.

Save a PET BASIC program on the Prime disk.

Load a PET BASIC program from the Prime disk.

Save a text file on the Prime disk and get it back to the 8032s.

Send a file (program or program control cards) from a Prime disk file to the IBM 370 for batch processing.

Send a file to be printed in the departmental office or to any of the printers of Weeg Computing Center.

Send and receive electronic mail.

Share text files with a collaborator.

If one compares this list with the original statement of the office of the future one finds that there is a great deal of overlap. There are no disks for individual work stations, but every other part of the vision has been

realized.

The list of operations that can be performed does not convey much about what the system looks like to the user. A principal consideration in designing the system was making it as easy to use as possible. This involved a threefold strategy. First, as with any computer, one needs a variety of codes to sign on to the Prime; this guarantees privacy and security. However, we wanted signing on and off to be automatic. Thus, the machine language program provided to each person has his or her sign on codes included in the program. When a user needs to go to the Prime the machine language program will send the codes for the user. This is a nice feature when one is first accessing the Prime. It is crucial when one sends or receives data from the Prime. All that one has to do is flip a switch on the modem and press the space bar, and communication is established.

Second, the entire system is run with two lists of options. When the user goes to the Prime he or she is presented a list of options on the screen. You can save or load a program. You can check your mail; if there is mail waiting you are told it is there as you sign on. You can decide to send mail. You can check any of the files that have been saved on the Prime. You can transfer files. Or you can go into normal terminal mode on the Prime. The other list of options is embedded in the text editor. In addition to writing and standard text editing operations the options include loading a file from the Prime, appending additional files, saving a file, saving a part of a file, or sending a file to be printed. With the exception of normal terminal operation all of the operations of the system can be chosen from one of these two lists. This means both that the system is easy to learn and that it is easy to move from one operation to another. This does not mean that the learning needed was trivial. Half of the people involved had never used a text editor nor interacted with a computer in any signficant way before. But

programs were chosen and written which minimized the difficulty of successfully starting and getting significant work done.

Third, the system was personalized in two different ways. One way was using individual's names everywhere that the computer expected sign on codes. When sending mail or transferring files the program on the Prime translates names into the sign on codes the Prime expects. The other way of personalizing the system involved a combination of public and private arrangements. Certain programs that run on the CBM 8032s are available to everyone, but each person can write and save their own programs. When the list of programs available for use is displayed each person sees all of the public programs listed, but only his or her own personal programs. The general mailing list is public, but there is also a facility which permits private mailing lists for committees or other individuals or groups who are not part of the public list.

The goal of this system is improving the productivity of the faculty of the department of political science. This goal is approached in two complementary ways. First, writing is a central activity of the faculty in a research oriented department. Anything that will improve effectiveness in writing will enhance the productivity of faculty members. Anyone who has tried one knows that an easy to use text editor is a quantum leap beyond a typewriter for writing and rewriting. Thus, by providing a simple but effective text editor to every member of the faculty our productivity has been improved.

Second, the university computing center provides many facilities that cannot be effectively duplicated by a desk top computer. For example, it makes little sense to perform complicated statistical analyses of large data files on a desk top computer when an I.B.M 370 or a Prime 750 is available. The same is true for plotting graphics, working with large bibliographic

files, and many other potential uses of the computer. In principle all of these activities could be carried out on a desk top computer, but in practice it puts a considerable strain on the patience of the user as the desk top computer grinds slowly through the process. Thus, by putting a terminal on the desk of each member of the department we have opened up to them a wide range of services that were before only "inconveniently" available. Members of the department who were already using the computer have taken full advantage of this potential. Those who had never used the computer before are just beginning to explore the possibilities. But that exploration will increase as they become more comfortable with computing.

The general reaction of the faculty is that the computer on the desk is a major boon in getting their work done.

There are two subsidiary benefits which result from this system of computing. The productivity of secretaries is improved. We have one fewer secretary than we had. Yet final copy of documents are now produced much more quickly than was possible in the past.

The desk top computer has a decided edge over terminals in offices from the perspective of general computing on campus. The demand for computing has grown by eighty percent leaps each of the last several years at the University of Iowa. The computing center cannot import equipment rapidly enough to meet demand. There are not enough ports for all the terminals that faculty and students would like to put to use. The various text editors are overwhelmed during certain peak periods of the year. The queue for accessing the disk grows and degrades system performance as the level of usage increases on the mini computers. Despite the extraordinary effort of the staff of Weeg Computing Center computing becomes less and less convenient as demand outstrips the capacity of the central facilities. If the department of political science had purchased 32 terminals we would be part of this

competition for scarce resources. By purchasing desk top computers which are used as stand alone machines a majority of the time we minimize our use of the central resources. Thus, we increase computing activity with only a modest increase in demand on central resources. Everyone is benefitted by our working "off line."

Is it possible to produce a similar system elsewhere? The answer is yes, but let me approach the justification for that answer in several ways.

Each year the political science departmental executive officers of the C.I.C. meet to compare notes. At the most recent meeting we discovered that word processing was happening in most of the departments. At the other institutions word processing is primarily an activity of secretaries. In one case there is a central dedicated computer with terminals in the department and in other cases there are larger stand alone computers which serve two to four terminals in the departments. Now to the point. For the two or three largest of these arrangements the cost was, as best we could figure, somewhat over one half the cost of our system. At least some universities are investing rather heavily in augmenting the productivity of secretaries with a "trickle down" effect on the productivity of the faculty. So cost does not seem to be an insuperable barrier everywhere.

The technology of putting together the system we have developed is beyond the capacity of most departments. But it to is not an insuperable barrier. The computing center staff at the University of Iowa has put together two other micro computer networks. Neither is as elaborate or as specialized as ours since they have been developed for people who are themselves regular computer users, and who, thus, do not require as much assistance as the naive users in our department. Computing centers have staff who can do this work.

The real barriers are two. Most of the faculty must type fairly regularly. Not many faculty members are likely to use a system that requires

typing if they have spent years putting words on paper with only a pen. Two, a great deal of attention has to be given to the education of all the people using the system. There is a lot of learning that goes on in implementing a system which is as simple as is ours. Someone has to be willing to devote time and energy to this task if the project is going to be successful.

The cost of computing drops very rapidly. The quantity and quality of software used improves very rapidly. Very powerful desk top computers are in our future. But we do not have to wait. It is possible to significantly enhance faculty productivity even now.

VIDEODISC - A TECHNOLOGY TUTORIAL

A Summary of Comments from a Demonstration at the

EDUCOM Conference

Kansas City, Missouri

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After years of promises and expectations, videodiscs are available for purchase in several formats. The format of the videodisc, as well as specific functional capabilities of the player, should be considered before purchase for use in an educational environment.

There are two general classes of formats: contact and noncontact. The RCA capacitance grooved system is a currently available contact system. The VHD capacitance grooveless player, also a contact system, is expected to be available early in 1982. The RCA system is designed for straight or "linear" playback of motion material, and is intended for use in the home. The RCA system is less suitable for university environments because of its inability to freeze a frame, lack of random access to a specific frame, availabiliy of only one audio channel and no provision for control by an external computer.

The noncontact or "optical" system offers the greatest potential for instruction. An optical disc contains up to

54,000 tracks of microscopic pits which vary in length and density on each side. A beam of light from a low power laser strikes the pits and is modulated as the disc rotates. The modulation is decoded and displayed as audio and video on a TV receiver or monitor. Each track contains information for a separate video image, giving a per side equivalent of 675 carousel slide trays of pictures or 1/2 hour of motion if viewed continously. Since there is no physical contact, each image can be read over and over resulting in a freeze or still frame. Optical players allow users to randomly access an image in 3-12 seconds depending on the player used. Most offer two distinct audio channels which can provide two different contents, be used in bilingual programs or provide multiple strategies for instruction as well as combining both channels for stereo.

There are two categories of optical discs available, reflective and transmissive. Reflective discs have a metallic coating and are protected with a clear layer of vinyl. This layer protects the information in the pits, permits direct handling of the discs, and causes the discs to be rigid. Only one side can be read at a time. By contrast, the transmissive discs are thin, floppy and transparent. They permit reading both sides of the disc without turning it over, but are sensitive to dust, fingerprints, etc. and therefore are kept in a protective tray except when playing.

All videodiscs mentioned thus far require expensive

specialized facilities for mastery and replication of the original material. A third category of noncontact videodiscs has been under development for some time and reputedly will be made public early in 1982. These systems, either photographic or using a recording medium unlike that used in current mastering, offer several advantages. They reportedly allow manufacturing and replication in hours, if not minutes, thereby reducing the turnaround time and expense. They will allow more local control over production and most importantly, facilitate formative evaluation of discs and repressing based on those results. I myself have not seen or used these systems and will await their introduction to assess their claims.

One final distinction needs to be made about videodiscs. Some noncontact systems are specially designed for educational and industrial use. These include the DVA and SONY reflective and the Thomson-CSF transmissive systems. These players are not only more durably built than their consumer counterparts, but offer an external interface and two-way communication for a computer. The Pioneer consumer reflective player has also been directly controlled by an Apple microcomputer using a commercially available board, though it allows only one-way communication from the Apple to the videodisc player. Two-way communication allows the videodisc player to send status information back to the computer including, among others, whether or not a command has been successfully implemented as

well as the frame number which is currently playing.

The DVA and SONY educational players can have an interactive program encoded into the audio tracks of the disc. When these discs are loaded into the videodisc player, the program is "dumped" into the player's microprocessor thereby letting the user respond with the numeric keypad.

If the disc can be interactive by itself, why use external computers?

In brief, there are several reasons. First, not all responses required of a user are best coded numerically in a multiple choice fashion. A textual response or nonkeyboard mode such as light pen, touch screen, joystick, paddle or voice recognition all require an external programmable computer. Secondly, the amount of memory in the videodisc player is presently very limited. You can get around this by including multiple "dumps" on the disc, but each dump adds to the cost of mastering. Finally, once the disc is mastered it is permanent and cannot be revised without remastery including audio, video information, and interactive program instructions.

What kinds of computers are used with the videodisc?

All kinds, depending on the application. Standard interfaces exist for the Apple. TRS-80's have also been used, as have the TERAK and larger mini and main frame and specially designed systems.

Keep in mind that videodisc and computer, particularly microcomputer, technology is in a constant state of flux resulting in improved performance and increased capability. What is true in the fall of 1981 may seem quaintly outdated in a year.

From this point on, my comments will presume we are referring to an optical educational videodisc system.

Why videodisc?

Unlike slides, film and videotape, there is no wear and tear on the disc or read mechanism. Discs are cheaper per unit to purchase than films or tapes, and when used to store large amounts of visual images, the per image cost is cheaper than slides. These cost comparisons are based on production and may change depending on what the market will bear as commercial developers enter. While the discs can be dubbed onto videotape, they are not easily duplicated into another disc. With a videoprojector, the disc can be used with an entire class. Most importantly, with a computer one can design interactive programs.

Interactive programs allow branching to a visual motion, visual still, audio or computer text and graphics depending on student response. Recording performance allows evaluation of the student as well as the program. Learner control as well as system control can be offered. Motion sequences can be shown in slow motion or still frame to observe critical

details. It is possible to overlay computer text and graphics on top of the videodisc image. This allows highlighting, cuing and other visual techniques, using a given visual for multiple instructional purposes as well as captioning for bilingual or hearing impaired.

Several university based videodisc projects are in existence. The University of Nebraska project has produced a number of discs. Many are captioned for hearing impaired students dealing with a variety of topics such as decision making and literature. Some discs are programmed to be interactive in a standalone mode including a Physics disc based on the Tacoma Narrows bridge collapse. Interactive computer driven programs use a TRS-80.

Physics instruction using a TERAK has been developed at the University of Utah while Utah State has been the site for special education programs employing a touch screen. A retrieval system for Hematology and a simulation of a nursing exam using a DEC 10 have been among several health science programs completed at the University of Washington. The University of California at Santa Cruz has used an interactive system to study the psychology of spatial learning. The Machine Architecture Group at Massachusetts Institute of Technology has developed some of the most memorable and far reaching applications including surrogate travel, spatial data base management and interactive personalized repair manuals. A bilingual English Spanish instructional program was

original audio visual material, instructional design and computer programming as well as disc mastering and replication and dissemination. Existing media cannot be cavalierly commandeered without copyright consideration. Videodisc turnaround can take from two weeks to two months.

As in any nonuniform, nonstandardized area, transportability can be a concern. While most reflective discs will play on other reflective players, they are not compatible with transmissive systems. Nor is the interactive programming on a DVA videodisc itself compatible with that on a SONY disc. Add to this the already diverse group of microcomputers and languages in use, and transportability can be problematical.

Present resolution with current 525 line NTSC television is insufficient for applications requiring fine visual discremination. Sound is not available with a still frame. Input-output modes are limited.

Once the technical concerns are ironed out, and they soon will be, we'll have a very nice delivery system. But deliver what? The most formidable of all concerns is in designing material for this medium - material which challenges, and informs, and captivates, and stimulates on a nontrivial level. Unless design accounts for the cognitive processes in learning as well as motivational impetus, interactive videodisc can become a jazzier, more expensive but equally dull and listless

developed at Brigham Young University. WICAT developed biology courseware under major NSF funding.

At the Weeg Computing Center of the University of Iowa, we have also developed different applications across several content areas using either an Apple II microcomputer or HP2000 minicomputer. These include retrieval systems in Art History and in Urology, testing programs for ballet, patient education modules, and interactive stimulus for visual memory research in psychology.

To verbally summarize any of these projects, as I am forced to to here, is an injustice. They must be directly experienced to obtain a true appreciation of the dynamic interaction made possible by videodisc player and computer.

Despite the positive virtues extolled thus far, there are some caveats and concerns. Bear in mind the technology, for all its seeming sophistication, is still in a relatively early, if not primitive, stage. Remember, "Due to difficulties beyond our control...," in the good old days of TV? That's infrequently seen today as the bugs have been worked out. So too with interactive videodisc - the technology is not yet 100% reliable. While improvements are made continually, "flaky" can still refer to more than just pie crust.

Costs associated are significant. Anticipated expenses should include the player, computer, producing or purchasing

extension of the worst of TV and of CAI.

Any promise for the future?

Yes. Work is being done on technical constraints such as resolution and sound on still frame, as well as more automated and less vulnerable methods of pressing and replicating the disc. Light pens, touch panels and other forms of allowing the user to respond directly and accurately to the video image are being improved. Videoprinters exist to provide a print of the image on the video screen. Graphic overlay of computer generated text and graphics directly onto the videodisc image is improving. Substantial efforts are being made to develop authoring systems to allow nonprogrammers to write programs. Some universities are beginning to offer coursework in interactive videodisc design.

The future will undoubtedly hold the digital disc with digitized video images in probably two to five years. Add these capabilities to cable and satellites, and the future looks very interesting!

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EDUCATIONAL COURSEWARE

Optical Programming Associates
445 Park Avenue
New York, New York

Telecommunications Technology Review

by Robert Gaynor

Robert H. Gaynor is currently Vice-President and General Manager of the midwestern region for AT&T Long Lines. Joining AT&T in 1942, Mr. Gaynor has held a variety of posts at various AT&T companies including Eastern Region Plant Manager, Division Plant Superintendent and Assistant Vice-President of the Operating Staff. He holds a B.S. from the University of Michigan.

Deregulation and the Technological Merger of Communications Systems and Computers

Daily, the options facing colleges and universities regarding which computer or telecommunications system to select for campus use become greater and more complex. As educators, we should be constantly aware of the challenges and opportunities this fast-paced development of technology presents. As information specialists, we should be experienced in the rapid growth of knowledge and the changing methods of assimulating and distributing this technology.

One factor continuously affecting both our development of technology and its distribution is deregulation. The Bell System is an example of how deregulation is currently affecting both business and society.

The FCC's Second Computer Inquiry mandated that The Bell System separate its network services (or basic telephone service) from its enhanced services and terminal equipment sales. The date set for the formation of the separate subsidiary is now January 1, 1983.

The creation of this new subsidiary means that within a few months colleges and universities may be buying telecommunications services and/or equipment from two Bell System groups or any one of a dozen other vendors and be billed by each vendor. It also means that campus information directors must become increasingly knowledgeable about equipment compatibility, service quality and which company is responsible for which service.

The FCC's ruling and pending legislation help define and legitimize the technological merger that has occurred between computers and telecommunications systems. That merger has made a host of "intelligent" networks available to the consumer, particularly the nationwide telephone network. Its components include 22,000 switching centers connecting more than a billion miles of wire and radio paths. It permits more than 14 million, billion connections among the nation's 175 million phones. It is upon this base Bell and their competitors will be building over the next decade.

Telecommunications Developments Within The Bell Network

About a decade ago, The Bell System began the process of deploying a nationwide network of software-controlled electronic systems larger than any other existing or planned computer network. This system, called the stored program controlled network, is — from the standpoint of technology — nearly complete. Almost three-fourths of all the long distance telephone communications in the United States are now handled directly by stored program controlled switching systems. By 1990, the nation will be totally covered by this intelligent network.

The first visible benefits of this programmable telecommunications network are such telephone options as call forwarding, message storage and retrieval, call waiting and conference calling. These services, now available in many cities, may soon be found nationwide. Your work can follow you across town or across the country.

In the near future, this intelligent network will also enable people who need to transmit data between homes and campus centers to hook up integrated service digital terminals to almost any telephone line. The greatest challenge, however, to both The Bell System and its competitors, will be to supply enough long haul digital facilities that can handle data transmissions rapidly and efficiently. The Bell System is meeting that challenge by making existing facilities handle more traffic and developing new ways of getting messages across the continent.

The AR6 (or single sideband radio) is Bell's latest innovation to expand current network capacity. Tested in the midwest in 1980, the AR6 has been added to more than 3,000 miles of existing microwave radio routes. It will increase the capacity of the radio relay network almost threefold upon completion in 1985.

Network capacity and efficiency will also expand as newer technologies such as satellite communications and fiberoptics are brought into service. Much

of the challenge of providing immediate long distance digital facilities will be met by satellites. The Bell System is planning on placing two corporate-owned satellites in orbit by 1985, increasing the company's satellite capabilities by about 15 percent. Additionally, Bell has a proposal before the FCC for a satellite and terrestrial system to handle a picturephone meeting service network (i.e. video teleconferencing).

Future satellite communications will differ from today's services in terms of flexibility and capacity. The use of scanning beams — a means of sending signals to specific geographic locations — was a concept developed by Bell Labs some time ago. Scanning beam satellites sharply focus signals, rather than scattering them, and would enable digital signals to be delivered precisely to hundreds of earth receivers.

Probably one of the most promising technological breakthroughs — especially for high volume data customers — is lightwave transmission or photonics. Lightwave systems transmit information in a stream of light pulses and are ideal for digital transmission. Today, lightwave systems are best suited to handle bulk digital communications. When used for high volume, long distance routes, lightwave systems are comparably priced with other advanced high-capacity telecommunications systems. In the late 1970s The Bell System installed an experimental lightwave system under the streets of Chicago. That system has since performed without interruption. Another lightwave system was used to carry television signals from the 1980 Olympic Games in Lake Placid. Bell currently has local lightwave systems in Orlando, Phoenix, Monroe, Connecticut, Atlanta and New York City. Additionally, in the summer of 1981, Bell began installation of a 611-mile lightwave route between Washington and New York, to be completed in 1984. By 1990, Bell's plans call for major nationwide routes.

From a network viewpoint, telecommunications "intelligence" is rapidly spreading out to the ends of the telephone lines. Bell has programmable switching centers and a growing number of digital facilities to carry messages. One of the problems the telecommunications industry has faced until recently was that there simply weren't all that many digits to transmit. We expect that "problem" to disappear as informational services become more cost efficient.

Telecommunications Use at Colleges and Universities

There are few places where information management is more important or a more viable option than on university campuses. Colleges and universities are a microcosm of the community. They may be the largest employer in the area, with responsibilities not unlike that of a major corporation. In addition, colleges and universities have traditionally served as "information exchanges," a role that will continue in the future....But the means through which that role is carried out will change.

As a representative of the telecommunications industry who has seen the impact of the information explosion on my business, I want to emphasize the necessity for applying communications systems in ways that enable colleges and universities to respond to community and business problems in real time. Today, the "immediate" absorption of campus research (i.e. genetic engineering) by business means that colleges and universities will require communications systems that give them instant access to information pools. "Pooling" information does not require future technology, but rather the application of technology we have today. Some of the possible meldings of campus services with technology may be:

- **Electronic Libraries.** Paper reference books are often obsolete before they're printed. In the future, reference books may be distributed (and updated) through electronic libraries. Students and professors could talk to a central computer via a keyboard or verbally and instantly retrieve the latest information on a particular subject.
- **Off-campus Audiovisual Centers.** While colleges and universities may still have "branch" educational centers across town or across the state, information resources like libraries and instructors could be housed on the main campus. Electronic mail, closed circuit television lectures and electronic libraries in conjunction with the proper terminals could turn any location, even a person's home, into a classroom.
- **Voice Synthesized Computer Instruction.** Advancements in electronic speech synthesis make it possible to have a computer teach a course while responding *verbally* to a student's typed questions. The Bell System has a software program that accepts text — even proper names — in normal English spelling. Using a software program with all possible speech sounds and the elements of human speech, it reassembles those elements while finding the answer to your question and responds. This happens in less time than it takes to explain the process.

Bell is also working along parallel lines to develop computers that can understand and respond to an audible human voice. Voice recognition computers could then be used for teaching foreign languages as well as in security system "voiceprints." Voice synthesis sales are expected to grow from about $23 million in 1981 to over $495 million in 1985. Voice recognition applications hinge on further breakthroughs in semiconductor technology and a better theoretical understanding of how humans hear and interpret sounds.

"The Bell System is an example of how deregulation is currently affecting both business and society."

- **Centralization of Administrative Functions.** Regardless of the size of your campus, there are dozens of administrative jobs that can be handled via a telephone line to a central computer. Some of the communications systems in use on campuses nationwide are: on-line fire detectors; burglar alarms and CCTV for security; police hot lines; centralized reading of gas, water and electrical meters; control of building heating, air-conditioning and lighting to minimize fuel bills and conserve energy; and hospital adminstration. While some of these services are centralized, others may be handled by small self-contained computer systems linked to other devices via telecommunications.

In addition, opportunities for new college services are becoming available as home information services develop beyond the prototype stage. AT&T, in conjunc-

tion with Knight-Ridder Newspapers, is conducting a six-month trial of electronic home information services in Miami. Called Viewtron, the system enables 160 Coral Gable families to call up 15,000 full-screen pages of information on their television. Viewtron services range from news reports to home shopping and home video banking. The British have a similar sytem, called Prestel, that they began testing in 1972. Prestel currently has more than 4,000 subscribers and provides access to 160,000 pages of information ranging from business news to data banks similar to those maintained by universities.

The Challenge

Today, we have the technology to do almost anything. We can create home, business and college environments that would have been viewed as science fiction only a few short decades ago. The challenge of the next few years will be to overcome the fears and resistence of people in our communities and institutions to the changes inherent in a knowledge-driven society. There are no institutions better suited to accept that challenge, nor any who weld as much influence over future leaders, as the nation's colleges and universities.

The learn/ALASKA Networks; Instructional Telecommunications in Alaska

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1. Abstract

In the last two and one-half years Alaskans have seen a remarkable process of educational collaboration evolve between the University of Alaska and the Alaska Department of Education in the arena of instructional telecommunications. This paper chronicles that evolution, the outcomes achieved to date, and projections of next steps.

2. RECENT ALASKAN TELECOMMUNICATIONS HISTORY

2.1 TELEVISION

From 1977-1981 the Alaska Department of Education aired up to five hours per day of network children's and family educational programming on the State of Alaska Television Demonstration Project (TVDP). In 1979-81 the University co-sponsored airing of several adult learning series; Sheldon Jackson Junior College was a co-sponsor of several of these offerings.

2.2 COMPUTER COMMUNICATION

Since 1976 the University of Alaska Computer Network (UACN) has offered an electronic mail service. This service is accessible to all University faculty, students and staff on all four year and community college campuses.

In 1979 the Alaska Department of Education, with support from the National Institute of Education, instituted an Electronic Mail System to link the administrative offices of Alaska's fifty-two school districts with administrative and support services of Alaska Department of Education, regional educational resource centers, the University of Alaska Teacher Placement Program and School of Education.

Concurrent with the Electronic Mail System implementation, a series of micro-computer based high school courses were developed by the Department, and introduced in a series of selected small rural high schools.

2.3 AUDIOCONFERENCING

Since 1978 the Legislative Affairs Agency has used a dedicated audioconference network to link legislators and their constituents for purposes of securing citizen participation in the state's legislative process. The Legislative Teleconference Network reaches 14 sites on a full-time basis, 5 teleconference sites, and 2 off-net sites (any Alaskan community can dial in on off-net). As capacity allows, other State funded entities are able to access the LTN.

3. EDUCATIONAL BACKGROUND

The University of Alaska is constitutionally mandated to provide public higher education in Alaska. The University has evolved from an original campus in Fairbanks established in 1917 to a statewide system of three four year and graduate level campuses (University of Alaska-Fairbanks, UA-Anchorage, UA-Juneau); and a Division of Community Colleges, Rural Education and Extension (CCREE) which encompasses ten community colleges, a division of rural education learning centers, and the statewide Cooperative Extension Service. As a Land-Grant institution, the University embraces a tripartite mission of instruction, public service and research.

The Alaska Department of Education is legislatively mandated to provide oversight to all public elementary and secondary education in the state. The Department also provides direct support of adult education and some forms of vocational education. Actual instruction is carried out by Alaska's fifty-two school districts.

In 1975, the State of Alaska committed itself to the construction and support of numerous small high schools in rural Alaska. Accordingly, a growing number of rural high schools are now in their first years of development.

4. LEGISLATIVE AND PLANNING BACKGROUND

In spring, 1979, the Alaska Legislature passed a resolution requesting the Alaska Department of Education and the Alaska Public Broadcasting Commission to assess the feasibility of utilizing television for instruction on a statewide basis.[1] Ultimately the study was jointly conducted by the Department of Education and the University of Alaska, with limited financial support from the Commission. Issued in February, 1980, the study called for the development of comprehensive interactive telecommunications services to support life long learning in Alaska.[2] The study recommended: the establishment of strong inhouse faculty and teacher orientation in the effective utilization of telecommunications for learning; the establishment of production capability for the development

of Northern-based curricula; and that an early emphasis be placed on the regional and cultural distinctions which so enrich the lives of Alaskans.

Three telecommunications systems were specified; 1) a full-time instructional television service linking all permanent Alaskan communities, with multiple uplink sites at the major rural and urban centers of the state; 2) a separate instructional audioconferencing network; 3) the expansion of the University's computer network to the six community college communities which were unserved at that time. Emphasis was focused on the need for interactive systems which could be meshed in flexible configurations to support instructional planning, information exchange, and administrative use.

In June, 1980, HCSSB 165[3] was signed into law by Governor Jay Hammond. This legislation funded the three services identified above. The University of Alaska and the Department of Education were funded to establish limited production and teacher/faculty development capabilities. The Alaska Department of Transportation/Public Facilities was funded to install, operate, and maintain the new (audio and video) systems. In that year's telecommunications funding the Governor, in his letter of transmittal with HCSSB 165 made explicit his decision to curtail expansion of the State's entertainment television service (TVDP) and instead to strongly support the establishment of the new instructional telecommunications systems.

In September, 1980, the Commissioners of Education, and Transportation/Public Facilities, and the President of the University signed a joint memorandum establishing the basis for inter-agency planning and installation/maintenance of the new services.[4] In this document priority sites for new service were identified. Here the University of Alaska Instructional Telecommunications Consortium was specified as the manager and operator of the television and audioconferencing networks. Detailed planning would be conducted by the University and the Department of Education, with the University as the central liaison between the Alaskan educational community and the Division of Communications of the Department of Transportation/Public Facilities.

In April, 1981, the first of the two learn/ALASKA networks became a reality. Approximately 100 Audio Conferencing Site Coordinators were trained in two-day workshop sequences, held simultaneously in Anchorage and Fairbanks. Service began--

In June, 1981, the legislature funded, and the Governor approved the expansion of the learn/ALASKA television network to an additional 120 sites.[5] This, in addition to the 100+ sites already under installation, would assure a comprehensive level of coverage to all Alaskans.

5. learn/ALASKA TELECOMMUNICATIONS SYSTEMS

In September, 1981, the learn/ALASKA operations function neared completion. The original date for the start of a full level of television service was postponed due to three factors: FCC licensing delays; finalization of earth station construction; and extended programming rights negotiations.

At the time of this writing (November, 1981) status is as follows:

5.1 AUDIOCONFERENCING

There are now 99 learn/ALASKA audioconferencing sites in 61 Alaskan communities. Each site has been established under formal agreement between the local educational sponsor, the other educational users in participating communities, and learn/ALASKA. This agreement assures multi-user access to the site, and identifies the individuals who shall receive site coordinator training, thus becoming responsible for local access and appropriate utilization of the network.

To date, the audio network has used dial-up long distance phone service via Alascom, Alaska's long lines carrier. Calls are bridged together via four interconnected twenty line Darome conferencing bridges. Capacity allows up to 16 simultaneous conferences of five separate parties each. Scheduling for University of Alaska instructional use is made on a semester basis. Shorter scheduling frameworks are currently used by the Alaska Department of Education, and school districts. More occasional users book network time up to one week prior to a proposed conference. Local audioconference participation is coordinated by the Audio Site Coordinator. Each established site has access to one or more portable Darome conveners (model 624). A convener consists of a small

(18" x 8" x 6") speaker, and four microphones linked into the speaker. A single phone line jack is used to interface a phone and the convener. The learn/ALASKA audioconference network uses the same phone circuitry used by Alascom for all dial-up long distance traffic.

5.2 TELEVISION

The learn/ALASKA television system is satellite based. The UA Center for Instructional Telecommunications, the operations and production facility of the University of Alaska Instructional Telecommunications Consortium, serves as operations center for the learn/ALASKA networks. The Center is housed on the campus of the UA's Anchorage Community College. Access to satellite delivered program sources is via the network's nine-meter earth station, located in Eagle River Valley outside of Anchorage. Programming is currently accessed from SATCOM F1, and the earth station, which is steerable, is technically capable of accessing the Canadian ANIK series. Through agreements with the local public television station, the network also has receive capability from WESTAR. From Eagle River, programming is microwaved to the Center, and is then directly fed via microwave to the Alascom toll center for uplinking to SATCOM 2, Transponder 11, or is taped for delayed transmission. The learn/ALASKA system will shortly have uplink capability in Juneau, Fairbanks, and Kotzebue as well; once uplinked to Transponder 11, programming is received, via small (4.5 meter) earth stations. Local distribution is via low power ("mini") transmitters, under the new low power licenses recently established by the FCC. In instances where telephone and other telecommunications traffic is higher, programming is received via Alascom's mid-route earth stations.

We are now feeding several hours/day of programming in a test mode to 78 sites. As additional licensing is finalized, new receiver-transmitter installations completed at existing earth-stations, and new earth-station construction completed, the number of functioning sites will increase to over 100. Programming hours will be increasing immediately, with achievement of the full 18-hour day targeted for December.

The Division of Communications (now a part of the State Department of Administration) is now initiating licensing for the additional 120 sites authorized by the last Alaskan legislature. These sites will become operational in the next 18-24 months.

5.3 COMPUTING

The University of Alaska Computer Network (UACN) communications capability has now been extended to all of the University's community college sites. The UACN electronic mail service, and the Department of Education's comparable service are jointly used for the scheduling of audioconferences, and other specialized communication in support of the utilization of the learn/ALASKA networks. This semester a computer-conferenced course has been conducted on the UACN, involving 60 students from throughout the state.

6. UTILIZATION CONSIDERATIONS

6.1 "CLOSED" VERSUS "OPEN" SYSTEMS

The very public nature of the learn/ALASKA television system, as opposed to the more private, and closed nature of the learn/ALASKA audioconference network and the University Computer Network suggests an important spectrum of dynamics for research and consideration in utilizing the networks to the best effect for the range of information and learning services required by Alaskans for the distance delivery of education. As important as the distribution characteristics of each system are the dynamics of local access.

6.2 TELEVISION

Our television system is a public network received in virtually every home in the broadcast area of the local "mini" transmitter. To the extent that we are successful in securing VHF licenses, and prime cable channels at no user cost in cabled communities, the learn/ALASKA channel will provide maximum local in-home access. All television viewers will have access at the twist of a dial. This type of primary access suggests that viewers participating in a formal or informal learning project via television will be doing so independently, or within the informal context of familial companionship (rather than with classmates). The very open distribution and public nature of this system suggests that its strengths as an instructional/informational delivery system lie in the arena of broadly-based educational interests and needs. The more specialized and advanced levels of learning of interest and relevance to specialized learner groups appears problematic for our

setting at this point in the evolution of television in Alaska. As greater channel capacity becomes a reality a greater degree of instructional specialization will become feasible.

Alaska's four time zones pose unusual challenges in the statewide scheduling of one channel. As important as the time-zone considerations, are the distinct patterns of rural and urban lifestyles, and the way time is used. Live instructional programming may well give way to on-site automated recording of programming for delayed local broadcast or in-home/classroom use. The University Instructional Telecommunications Consortium has provided automated video tape recorders to many University sites to facilitate the latter type of use.

The video network is beginning service with the preponderance of programming coming from "lower 48" networks and distributors. The University and the Department are independently undertaking the production of instructional programming particularly relevant to the Alaskan setting. The Department's production is being contracted out, while the University is initiating in-house production through the Telecommunications Consoritum (UAITC), and local University units.

6.3 AUDIOCONFERENCING

The use of audioconferencing units (conveners) enables groups of participants at multiple sites to participate in group conferences with each other. Audioconferencing requires the timely attendance of all participants, as time on the network is allocated into a fully developed schedule. Local access to an audioconference is coordinated by the local Audio Site Coordinator. Effective use requires participants familiarity with the equipment (Push-to-talk microphones). The two wire system we currently use requires that only one participant talk at any one time; when two conversations are initiated simultaneously transmission is blocked. Thus, when the system is used informally (without a facilitator or chairperson directing participation), a good degree of participant familiarity with each other's speaking styles is required to avoid the "blockage" phenomenon. The more common, and more formal pattern of use is for the audioconference sponsor to serve as facilitator, or to request that another individual serve in this role to guide participation.

While it is technically feasible to use a hand phone set for participation in an audioconference, this type of use is discouraged for several reasons: costliness of individual lines being tied up (versus local users congregating at a designated site and using the convener); user discomfort which comes from extended discussion over a hand-held phone; and decreased sound quality. Thus, users must be able to conveniently access the local audioconferencing site.

6.4 COMPUTING

Use of the UACN requires user ability to gain access to a public or private terminal located at a University facility. Alternatively, access requires that the private micro-computer user have connect capability. In all instances, one must have a user identification name, assigned by the UACN to faculty, students, and staff so requesting. However, user file space, an important commodity for active users, is allocated differentially depending upon user status, and ability to state their case for file space. Access to campus-based terminals is problematic to most users at this time. University faculty and staff who are fortunate to have a terminal in their office enjoy better physical access than do most students currently. However, user demand has burgeoned in the last 12 months, so that physical access is just the first step to actually getting "on" the system. Saturation is most frequently occurring during office hours. The lack of time constraints involved with computer usage, one of the most potentially liberating dimensions of computer-based communication, is thus contradicted by the scarcity of network access.

7. THE EFFECTS OF PLANNING WHILE YOU "DO"

The rapid legislative response to the UA-DOE Feasibility Study which proposed comprehensive instructional telecommunications services for Alaska has required that we adopt a simultaneous planning and implementation strategy. The magnitude of system planning and implementation has been great, and the dynamics of University-State-School District relationships complex. We have moved a great distance very quickly; the next year promises additional rapid growth with the further extension of the television network to 120 new sites.

The focused attention which faculty/teachers, and students must receive in a manner which correlates with program production and adaptation has been underway since the inception of the networks. However, the consuming demands which network development has placed on us unquestionably diluted the magnitude of user support services which Alaskans, as learners, or providers of learning resources, require to harness the networks to their own ends.

Within the University and the Department of Education an increased emphasis on these two functions is now being addressed.

This past semester the UAITC and the University of Alaska-Fairbanks cosponsored a course on the social impact of instructional telecommunications in Alaska. The course was delivered via use of printed texts and readings, with student and faculty interaction occurring via the UACN electronic mail service and audioconferencing. Sixty students participated statewide. This course, offered by Ron Scollon and Suzanne B. Scollon, created important incentives for participants (many of whom are University faculty and staff) to gain proficiency in uses of the mail system and audioconference network. Audioconferencing among diverse sectors of the Alaskan educational community has become a relatively familiar and comfortable experience.

This next semester will see the first broad scale availability of the learn/ALASKA television service, and user orientation and experimentation in a stand-alone as well as complimentary capacity with audio and computer conferencing.

Basic research and exploration of the dynamics of inter-ethnic communication via telecommunications is in its infancy. Two productions which draw upon the British Broadcasting Corporation's productions on inter-ethnic communication in Great Britain, (the "Crosstalk" series), are now under development as pilot projects which explore communication in Alaskan cultural contexts.

Several Alaskan-based educational television series for children are in completion stages under contracts let by the Department of Education to Alaskan producers collaborating with local school districts.

Demand for user orientation, production services, and technical assistance exceeds our current capacity. We are moving to increase the depth of our services by integrating experience gained in other settings with our own experiential base.

In the next year we shall develop an instructional telecommunications plan in response to an executive order of the Governor which reorganized telecommunications services within Alaskan state government. This process, meshed with our respective internal planning sequences, is a significant "next step" in the further development of instructional telecommunications in Alaska.

FOOTNOTES

1. Alaska State Senate. "Senate Concurrent Resolution No. 35, Directing the Legislative Council to Conduct a Feasibility Study Relating to Educational Television." Juneau, Alaska. April 23, 1979.

2. Alaska Department of Education, University of Alaska, Alaska Public Broadcasting Commission. "A Report on the Feasibility of Telecommunications for Instruction in the State of Alaska." Juneau, Alaska. February 15, 1980.

3. Alaska State Legislature. "House Committee Substitute for Senate Bill 165 (Free Conference Committee). Making Appropriations for Operating and Capital Expenses Related to Telecommunications; And Providing for an Effective Date." July 2, 1980.

4. J. Barton and M. Lind. "Joint Memorandum to Mr. Robert Ward, Commissioner, Department of Transportation & Public Facilities." Fairbanks and Juneau. August 14, 1980 (date of transmission to Ward).

5. Alaska State Legislature. "Free Conference Committee Substitute for House Bill 50. Chapter 82. SLA 81." Juneau, Alaska. July 22, 1981, Effective Date July 23, 1981.

Implications of Advances in Television Technology for Higher Education

by John Blessington

Director of Educational Relations for the CBS Television Network, John Blessington is in charge of the CBS Television Reading Program that supplies schools with scripts and Teacher's Guides for a variety of prime-time sepcials. Prior to joining CBS, Mr. Blessington acted as the Educational and Family Life Advisor to the Sea Pines Company, Hilton Head, South Carolina. For ten years he was Headmaster of the Whitby School in Greenwich, Connecticut, the founding school of the revival of the Montessori method in the United States. Author of and contributor to several books on education, Mr. Blessington also conducts executive and management workshops and seminars. He holds a B.A. in Philosophy, an M.A. in Philosophy and Education, and various credentials in Montessori Education.

The Present State of Television

Since television began in England in 1936 and this country in 1939, and all through its slow but dramatic development, it has played an increasing role in our lives. Whether university faculty or members of a family, we have seen television as wonder, curiosity, convenience or complicator in public and private life.

This 40-year period is now called by some Television I, because we now face a period of even greater advancements to be called Television II.

Television in its beginning was marked by the miracle of a signal transmission becoming a picture on a screen, and by the corresponding growth of public interest, as well as its growth as a commercial enterprise. Programs developed, major events were covered, and starts were made in politics, sports, news, drama and comedy; every manner of entertainment and information filled the screen from decade to decade — each fuller than the last.

It was one hundred years ago that an English cartoon depicted live action of a desert war being viewed and cheered on by people back in England. Today, this is not far off the reality of coverage of remote parts of the world brought to us live via satellite transmission. All the technology, which is part of the computer world as well, has increased the reliability of television transmission in addition to reducing the weight, size and cost of actual equipment.

What kind of television system do we have in place today? Now, television reaches almost 80 million homes — over 97% of all homes. More than 80% have color TV and about half have two or more sets. The system contains about 1,000 stations: over 600 in the three major networks, a host of independent stations (most stations are independent even though they are linked to a network) and about 263 non-commercial and educational stations. A number of these are attached to universities in one way or another, but very few universities own their own commercial station.

This means there are about six stations available for viewing in a typical city: the networks, independents and PBS in almost all cases. These provide 120 hours of programming every day of the year, and sets are turned on in most homes for about seven hours each day. News, sports and entertainment are the main formats, delivering a vast variety of information that covers almost every aspect of human life and every category of every department curriculum at a university. But commercial television in particular does not intend nor pretend to be a schoolhouse or a lecture hall.

Local television news, along with local newspapers, supplements the national news and covers what is regionally or locally important. Television news is swifter and more dramatic than newspaper reporting, but it is not as extensive in its depth of reporting nor does it afford the easy review built into rereading print. This is television today — extensive, available, pervasive, informative, entertaining...and expanding. We already have video cassette retrieval, videodisc, cable channels and satellite transmissions that are making international television viewing more common. What is next?

Here are several of the forecasters' projections:

Cable. Cable television, which began as a community antenna system and now reaches more than 15 million homes or about 20% of all U.S. homes, is expected to reach over 30 million homes by 1985.

What began as 12 channels per cable system is now at 72 channels in many systems, and at least one cable operator has proposed a 120-channel system for several communities. In addition to the monthly cost for basic service there are special pay services available for added fees if a home viewer wishes to subscribe.

Satellites. One hundred fifty-six transponders now transmit television signals around the globe 24 hours per day. We can only look for this to increase.

Growth with population. As the population grows print literacy and telecommunications also grow. The viewing public can now choose from:

broadcasting
cable
VCR (video cassette recorder)
disc (videodisc)
teletext
interactive TV
video games
computers (in the home using the video screen)

All of these are part of TV and in the very near future will clearly move into a more central role in daily American life.

The implications for a university are many even if they are not clear.

Consider the following:

New students. Advances in television technology will enhance the ability of a student to obtain more information more readily. It will also allow many people who would not consider themselves likely candidates for advanced learning to obtain continuing education.

Repetition for learning. The ability to record from television will allow many fine pieces of drama, science, literature, history, etc., to be viewed time and time again; and, not unlike the book — television will now be a form of learning with a capacity for repetition.

Interaction. Interactive television will allow people to react to a presentation in a somewhat limited yet active dialogue with an instructor. The television set promises to become not just an entertainment center in the way we have known it during Television I, but rather, during the next phase tentitively entitled Television II, it can become a larger set of windows on a larger but shrinking world. Television as technology may be a lecture hall of enormous capacity, becoming a seminar of almost overwhelming size.

Reduced cost and increased use. We can assume that as the cost of new video instruments falls, their production and use will therefore rise. And just as with the calculator and other recent technologies there is every reason to predict the majority of the public will seek to take advantage of the many ways of receiving information even if their final goals differ. Many students will be able to afford, and will use, television as a learning tool.

Teletext. I have seen the uses of teletext-television print (at CBS we call it extra vision) in various demonstrations, and the possibilities for higher education are exciting. A variety of library-style services can be delivered to the home via teletext — and any form of print information can be attractively programmed and selected through technology already at hand and operating. Colleges and universities can be both sources of information and users of this delivery system.

Low-power stations. In the near future, the FCC will allow a number of low-power stations to come into the market. These will be local stations with a 10-mile signal radius that can add some of the neighborhood or small town flavor still missing from local television. Colleges with local stations will be offering remote instruction for commuter and resident students almost immediately.

Sound and video technology. Stereo sound plus high definition pictures and larger screens will make certain types of video presentations more attractive and capable of sustaining our attention. The development of the 3-D television image offers a host of new video formulas relevant to instruction, recruiting students and to maintaining good town-grown relations.

Digital transmission and storage. Using a digital signal to trigger a response on the tube allows for increased transmission capacity and a staggering tolerance for the storage of television programs, all at reasonable cost.

How long it will take these various technologies to become cost effective for specific types of television production is difficult to forecast. What is possible to forecast is that science and industry will continue to make abundantly more available that technology which already exists.

Educators and Television

Most professors, librarians, researchers and others within higher education have disdained television as exemplified by the content of commercial television.

However, that television technology has become a major facet of modern life is a fact most educators will have to accept. The sadness lies in the fact that the educational community has not been very helpful to the development of constructive attitudes toward telecommunications or the skills to use with it. Although television has been perceived as a threat to the educative process by many teachers, there is a general attraction on the part of viewers to the video screen. For almost three decades now, most of the educational community has stood against or ignored television. Only a select few university departments and individuals have engaged in the pursuit of the constructive uses of this technology.

While I wish this state of mind had been different, it is easy to understand the educator's resistence. We know the printing press was not heralded upon its invention, nor were the steam engine, radio, motion pictures or the airplane. They were all viewed with fear and suspicion by the general public. As educators we are specialists, and our mode of expression is oral first and the written word second. These verbal skills are not rewarded as readily through television. It appears to many that a person has to be a star, and most professors do not look upon themselves as star quality. The fact that their students also share this perception only heightens the anxiety. The presence of other professors or university staff who are comfortable with, and perhaps excited about, the uses of television or other technology does not make an uncomfortable professor comfortable. We have little to assure us that unless we train ourselves and our staffs to understand and be comfortable — even playful — with the advances of television, we will not suffer from stop and start growth in this important area.

"This 40-year period is now called by some Television I, because we now face a period of even greater advancements to be called Television II."

University Policy

What are the possible implications of advances in television technology for university policy?

I suspect that as television enters its Phase II, the university will also be entering into University II. In education we often speak of renewal, but University II is more than this. Since the foundation of the medievil university, no time period seems to have called more for change than our immediate past and the immediate future. We no longer need the university to be a stationary setting for the informed and the scholarly; it is no longer a book depository. The university is now becoming an interactive community of diverse people and information systems.

The students of today are quite different, and a decade ahead they will be ever more different. Student IQs may be about the same as the 1940s and 1960s, but the information base is different. We can continue to curse the loss among some of these students of basic skill refinement or we can use the new technology to close that gap and link their experiences with the challenges the 21st century presents.

What will we do when a student comes from a home with either 120-channel TV or a direct broadcast satellite dish on the roof of his home? Suppose she has bought the CBS news tapes which cover much of the history of the past twenty years prior to her birth; or suppose she has interactive TV games or a teletext service which is linked to a library? Does this not suggest a different set of tasks or a different emphasis for the university? Yet, as in the tradition of the university, the mind is still to be challenged with ideas. The skills of communication and reasoning will still need refinement and development. The enthusiasm and love of a discipline will still need to be transferred to the student — of this we are certain.

Are we willing to share the most gifted professors or will we still say their class is full when we could use closed circuit or cassette-recorded television? Will our individual libraries be limited or will we open them to cooperative library service via video? Will we allow the students of the '80s to obtain a degree and be untutored or unrefined in television and telecommunication technology? If we leave television completely to their private lives or to the business community, what will these future alumni think of their time with us?

What about the campus? Is it as important as it once was to a university? Will we have many campuses with interconnections via telecommunications? Will the campus stand as a monument of service to our clientele or as a monument to a bricks and mortar nostalgia? Can we have both a central campus and satellites which are equal in tone? I'd like to think we could.

However, if we do not help the individuals on our faculty to become knowledgeable and comfortable with these advances in television, a gap will grow between the proessor and the student, the professor claiming the print and the spoken word is superior while his students see these as, at best, equal and not superior to telecommunication. Can we finally allow more individualization of instruction, since lectures and demonstrations can now be recorded on cassettes or discs and reviewed in the library or played before repeat audiences in lecture halls with wall-size screens or on multiple monitors?

What about professors who have that star quality but are not top scholars...how will they be used? Will they be abused or will their talent for communication be tapped to serve the students through advanced television technology? Will we see the chance for more instruction, more variety in presentation and hopefully more learning, or will we argue about who are truly the best scholars? We have all suffered under brilliant professors who lectured poorly or wrote obscurely. Now we can reduce this frustration. We also know that some brilliant professors who are not good classroom communicators can be assisted to use television to effectively carry the message they truly wish to convey.

University Business Affairs and Television

It may be more comfortable to apply television technology in the business affairs of the institution. The business end of university life has always looked to systems to help it do its work. Maintenance, finance, logistics, food service and residential life can all use some aspect of these technological advances to reduce some of the workload or to increase service.

Will television cut costs? Maybe, but I think it unwise to look for cost reductions. It is more likely the costs will shift. You may reduce a department size by one or two professors and increase it by another staff member trained in television technology. Universities, however, will be able to operate 365 days a year, 24 hours a day, given that a professor can lecture or present an experiment many times over via a television cassette without doing it more than once before a camera. This will be a great service to students.

What about admissions? Could we not use television to present our message across the country and save on the cost of travel on both sides? What about academic guidance? A department could present its program and facilities via TV to help a student understand what the department really offers.

Perhaps international students could be assisted in learning our language and culture and in finding their way around the community more easily via a well-directed television presentation. Think of the comfort to them if it was presented by a mix of Americans as well as students and faculty from their native land.

What with the world shrinking all the time, think of how valuable it might be to present the lives of foreign students to native American students as a way of reducing the isolation that often affects these students and the awkwardness that often accompanies an American's attempt to befriend them.

In addition, the alumni office could use a satellite transporter to teach alumni gatherings on the same night all over the country, perhaps with some interactive television response.

Members of the Board of Trustees would not have to be mere photographs in a bulletin. They could express themselves to students via studio television interviews and have the students present opinions through the same forum or through interactive television. The process

could be both more instructive and less threatening to each.

Now, the major implication of these advances has much more to do with educating the educator than with the technology itself. Our technologies are already ahead of their use in schools, colleges and universities. In order to sense the power inherent in television, we have to experiment with the technology, become relaxed about it and separate this experience from the viewing of commercial television. It is unwise, however, to think that the university can easily use the medium without relating to those in commercial television who have learned to use it and have through trial and error found out what works and does not work even within a narrowly casted program.

It seems very unlikely that television will ever replace teachers, librarians, researchers or professors. It seems more likely that television will be an additional tool for all of us to use in order to serve the great and increasing demand for information. If the United States is an information-based economy, then the university will be held responsible in part for making students capable with the new technologies of communication that are the tools of an information-based economy.

The big question for long-range planning and academic review as well is, "What do we want from the advances in these sciences and how will we employ them to serve our needs?" The university ought to mandate — and this may require a policy review — that television and telecommunication be discussed fully each year by an interdisciplinary university community to allow the faculty members, administrators and students to learn and plan in an atmosphere of relaxed exploration.

Conclusion

We have 19 years left in this century and three objectives to start work on now. We should:

- Help to increase the university community's knowledge about television
- Train faculty and students in telecommunications skills
- Set up programs for students, faculty and staff that have as their goals the development of television and telecommunication competency and ease

If a university is to touch upon the universe of its time and to help make the information-based economy manageable for its students, it will require all the available technology in order to accomplish the task.

■ Mr. Blessington invites the inquiries and comments of all *Bulletin* readers. Send your inquiries to: Mr. John Blessington, Director, Educational Relations, 51 West 52nd Street, New York, New York 10019. As general reading, John Blessington recommends *Television, The Book, and The Classroom*, edited by John Y. Cole, 1978 (Info. Office, Library of Congress, Washington, D.C. 20540).

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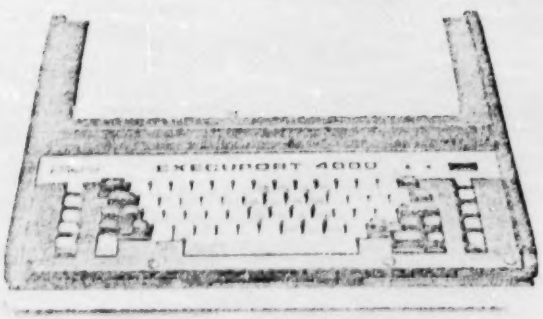

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NATIONAL INFORMATION POLICY ISSUES AND HIGHER EDUCATION*

Irving Shain, Chancellor
University of Wisconsin-Madison

I am very pleased to be able to join you today and to have this opportunity to share with you a few thoughts about National Information Policy issues and their interaction with higher education. I would like to take the next few minutes to introduce you to three themes--each of them familiar to you, I'm sure. They are:

First, that the United States is rapidly becoming an information society.

Second, that national information policy is a subject that warrants your attention.

Third, the issues of information policy need to be on the agenda of higher education.

Becoming an Information Society

Economist Fritz Machlup's pioneering study in 1962, The Production and Distribution of Knowledge in the United States, brought the first attention to a major shift in the nature and distribution of the United States' labor force. Later, his student, Marc Porat, in his work for the Department of Commerce in 1977, The Information Economy, showed how rapidly that shift had taken place.

In 1977:

46% of the gross national product went into producing, processing, and distributing information goods and services;

53% of all labor income was earned by information workers;

17 cents out of every consumer dollar went into the direct purchase of information goods and services.

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* Based extensively on Computing in Higher Education: An Accidental Revolution, by Robert Gillespie, University of Washington. Presented at the Educom Annual Conference, October 21, 1981.

The work force has shifted from a situation where about 40% of the people were engaged in farming and another 40% in industry to one where agriculture is but a few percent and industry has declined below 20% of the work force. The loss from those areas has gone into service and information industry growth.

While we are all part of the greatest information industry of all time, education, we might not have realized what was happening around us. Currently, higher education is, in the United States, a 50 billion dollar a year industry. But business investment in training and other educational processes is currently estimated to be 60 billion dollars each year. World wide, the computer industry is over 60 billion dollars annually. The percentage of the GNP spent on computer usage was 2.1% in 1970; it is expected to be 8.3% by 1985.

These rapid shifts have not escaped attention in other nations. In Japan, a national plan for a transition to an information society was developed in 1972. Entitled The Plan for an Information Society--A National Goal Toward the Year 2000, it was presented to the Japanese government by a non-profit organization and was used as a basis for national action.

The plan was based on the assumption that it would be in Japan's interest to capitalize on its greatest resource--its human resources--and accelerate movement to the information society and an economy based on it. Thus Japan continues to move through the stages of society, from farming, through industrial and next to the information society. Also this gave hope for a move toward a non-polluting industry which also did not depend on scarce material resources. The plan set out a series of major projects including national administrative data banks, computerized cities, new medical systems, pollution prevention, experimental school

systems and a number of other innovative projects. The plan called for an investment of 65 billion dollars between 1972 and 1985. While that level of investment was not reached, most of the projects proposed have been initiated. We have witnessed the rapid rise of the Japanese electronics industry and some of you may have seen some of the results of the wired cities which are being used to determine which consumer services are both desirable and economically feasible using new teletex and video text facilities.

In France, the publication of the 1978 report, The Computerization of Society, focused French attention on both the social issues such as potential unemployment and the need for re-education as well as the necessity and opportunity to compete for a share of the world information market. It provided a focus for French public opinion and dramatized the rapid shifts taking place. For instance, one of its assumptions was that:

"Mass computerization will take hold, becoming as indispensable to society as electricity."

A number of significant actions have taken place since the publication of the report:

-- A videotext system (allowing access over telephone lines to information through a very inexpensive terminal), is being used to replace telephone books as a first step to nation-wide information access.

-- Over 10,000 microprocessors are being placed throughout the school system.

-- A very strong program for training of teachers and development of tested curriculum materials is in place and supported at a national level.

In 1979 the West German government announced a 500 million dollar program in information technology aimed at understanding the social impact of technology, increasing the country's ability to create products using the new technologies, and improvements in communications facilities.

In England, the government, in addition to a plan to incorporate microprocessors in every high school and also to provide significant government support to improve the semiconductor industry, has created a ministerial level post responsible for information and communications issues.

What is the United States Doing About Information Policy Issues?

The U.S. approach to these issues differs from the approach of nations with more strongly centralized federal governments. State and federal governments attack these issues from different perspectives, and the results are a fragmented and haphazard approach to the information society.

The concern with what has appeared to be an absence of national perspective in this area has resulted in the introduction of a bill to establish an approach to formulating national policy in this area.

The Information Science and Technology Act of 1981

Representative George Brown of California first introduced a bill in the 96th Congress aimed at providing a focus for national information policy issues. A revised version (House Bill 3137) was introduced in the 97th Congress, and hearings on the bill were held in Washington last summer. Brown's approach to the variety of issues is to create an independent agency, an Institute for Information Policy and Research, which would have a lifetime of 10 years, unless extended by Congress. The Institute would be viewed as a transitional mechanism to facilitate the nation's evolution into an information society. There are several key ideas incorporated in the legislation. Among them: The Institute would provide a mechanism for bringing together government, industry, and other public sector areas to identify and work together on issues

of information policy and the Institute would initiate studies of information policy issues, using the existing expertise in universities, non-profit institutions and federal agencies to look at the relationships among information policies and to identify the long range needs and impact.

The hearings showed that concern with information policy issues was high and both federal agencies and private industry felt that the current United States approach exposed us to risks because of international competition and the sharply focused efforts of other nations. Still, there was no agreement that the particular solution suggested by Congressman Brown was the most appropriate one at this time. It is clear, however, that these issues will continue to draw national attention. Certainly the current administration's focus on the budget has set aside consideration of long-term issues such as information policy--it has even set aside consideration of the role of education as a critical national investment. It is too bad that the chart of accounts has no space for human resources!

Information Policy and Higher Education

I have reviewed these national and international activities because I feel that we have failed to make the connection between higher education and information policy. Certainly educational journals are filled with articles describing the changes coming in education due to the rapidly developing areas of computers and technology. However, we must be concerned that higher education is resistant to change. Few university administrators have used computers as tools in their studies--before they were administrators, that is. Few administrators know what is behind that endless sink for money, the computer center, and that we are still in

early stages of its use. All of them are familiar with the library and the way it has become an accepted part of the institution. Unfortunately, we are trying to do with computing in one generation what took twenty or thirty generations with libraries. I estimate that most universities spend one or two hundred dollars per year per student on their libraries. That kind of expenditure, if used for computing, would provide for each student thirty to sixty hours of terminal use per year. Those are the amounts provided by only a few of the most forward-looking institutions today.

Unfortunately, all this is happening at a time when all of higher education is going through retrenchment--if not through base budget reductions--then through the effects of inflation. Under the circumstances, I can assure you that even administrators who are very sensitive to the increasing importance of computing in our society are finding it very difficult to respond to the need for additional faculty and staff positions and additional equipment and facilities.

Recently I participated in a panel that was convened to review a study about computing and higher education that was performed for the National Science Foundation by Robert Gillespie from the University of Washington. The title of the study is Computing and Higher Education: An Accidental Revolution. One of the results of the panel was to introduce me to the use of the term "information society." Another of the results was a brief consensus statement on the issues of computing and higher education. There was substantial agreement that the information society was at hand and that higher education, industry, and the federal and state governments must pay attention to the issues or risk losing both our economic and intellectual leadership role in the world.

Incidentally, the panelists were not just members of the computing or higher education establishments, but were drawn from a variety of sectors and backgrounds in education and industry. I was surprised at how easy it was to reach a consensus on the issues and recommendations.

Our recommendations were directed toward industry, higher education, the administration and Congress. Our major recommendation was directed to the National Science Board. We recommended that it would be appropriate for the Board to take a leadership role in bringing together the variety of efforts needed to strengthen our national approach to higher education and computing. The Board is still considering the recommendations and I hope it will be able to act soon. However, even without the Board's action there is much to do. These issues must be placed on the agenda of organizations within and outside of higher education. This conference is a good example of the kind of joint activity that is needed. I'm pleased to see that this is a conference jointly sponsored by EDUCOM and the American Council on Education. I think that it reflects the growing awareness of the importance of computing to higher education.

Another example of the efforts needed to link industry and higher education is taking place in the computer industry itself. Recently the Computer and Business Equipment Manufacturers Association (CBEMA) sponsored an ad hoc committee to investigate the nature and impact of the human resource shortages in programming and engineering fields. They not only have identified some of the educational issues but are working toward effective support from their membership to participate in curing some of the problems.

I might add that in my view, universities are ready to take a new look at developing relationships between industry and the academic community. The "brain drain" from our universities has reached alarming

proportions, and if the trend is not slowed very soon, we will have only a few old-timers and some foreign graduate students doing the bulk of the teaching in fields such as computer science and some engineering departments. Under the circumstances, I have noted a willingness on the part of university administrators to accept faculty consulting activities and direct involvement in proprietary research as a way of sharing scarce faculty resources with industry while still retaining a portion of the faculty time focused on teaching and basic research.

In closing, I hope that I have called to your attention some of the national and international information policy issues. And I hope that I have enlisted you in the effort to bring these issues to the attention of those people and organizations inside and outside of higher education that should take part in carrying out an aggressive program to resolve the issues.

Riding the Wave of the New Information Technologies: The Administrator's Role

by Joseph Lipson

Joseph Lipson is employed by WICAT Systems, Inc., a videodisc company in Orem, Utah. Before joining WICAT, Dr. Lipson served for three years as Director of the Science Education Development and Research Division with the National Science Foundation. An original member of the Learning Research and Development Center of the University of Pittsburgh, Dr. Lipson has worked as the Associate Vice-Chancellor for Academic Affairs at the University of Illinois and Vice-President for Academic Affairs at the University of Mid-America. He has also been a member of the planning unit for the National Institute of Education in Washington, D.C. Dr. Lipson holds a Ph.D. in Physics from the University of California.

Incrementalism and "Single Loop Learning"

Chris Argyris, a student of management and organizational behavior, recently contributed to and edited a book entitled *Leadership in the 80s*. Since college administrators are charged with being leaders in our society, and since I am concerned about the interaction between leadership and our response to the wave of computer development, I would like to quote some of his thoughts that I found in a review of the book.

"Argyris starts with the assertion that public confidence in public and private organizations' competence to perform effectively, and in that of the professionals in management, including educators, is at an all time low. He attributes this condition to the failure of management to go beyond what he calls 'single loop learning,' defined as the detection and correction of errors in routines of operation. Important as such learning is, it is not sufficient because it does not deal with changing underlying values and policies.* As the latter change, the routines and policies are a misfit. Hence a 'double loop' is required, one that includes training in the skills of invention and of the production of solutions and their evaluation."[4]

I would like, toward the end of this paper, to develop the theme that it is important for the administrators of our higher education system to develop this more inventive, problem-solving behavior in order to realize the contribution that new technologies can make to our intellectual life.

A friend of mine, Mike O'Keefe, once said that administrators tend to make incremental decisions — paring a budget item here, reorganizing a little there. From my observation, incrementalism inhibits the invention of solutions needed to fully exploit the new information technologies. My perspective is that the computer, the videodisc and communication networks have the potential to (a) improve the quality of research; (b) enhance instruction in conventional college subjects (e.g., foreign languages); and (c) enable us to teach new classes of knowledge and skills efficiently and effectively (e.g., how to carry out laboratory procedures or how to operate a nuclear reactor).

However, most of our universities are not geared to ride the wave of the new technologies. Our budgeting practices, our organizational and decision structures are not geared to be in phase with a technological system that is changing as rapidly as the computer and related technologies. If we are to respond effectively to the challenge and the opportunity of these new technologies, I propose that administrators will need a new perspective, a new world view, a new relationship to the faculty that will free them to become the inventors of administrative solutions of which Chris Argyris speaks.

New Technologies Creating a New Perspective

In order to begin to sketch this new perspective, I will first describe, briefly, the new technologies and some of their interesting properties for college instruction and research. Second, I will speculate on what will be available about five years from now. Third, I will offer my list of the issues that administrators will face. These issues include the following: money, who benefits and who pays, where to get computer professionals and technology-oriented faculty, changes in student entry and leaving standards, reluctant faculty, reorganization and communication with the outside worlds of government, alumni, industry, etc. Fourth and finally, I will make some recommendations regarding the kinds of initiatives that administrators might take.

Information Technologies Today

The symbols of the wave of information technology today are the microcomputer, the word processor and the computer network. The use of these seems to be growing so rapidly that they give a sense of momentum and dynamism. They are penetrating our society because they capture the imagination of people who want access to them, and

*This author would also add "changes in the dominant technologies."

because their economic benefit and potential is so clear that manufacturers, sellers and buyers all make a commitment to become involved. However, if we consider the world of ideas and knowledge, it seems to me that the following computer-based technologies are especially important: the videodisc, speech synthesis, voice recognition and optical character recognition. Before we consider these in detail, we must consider education and research as information-limited fields to provide a context for what follows.

Education and Information

We all live in an incredibly rich sea of information. The problem is to acquire the knowledge and the models that will help us to decide (a) what to notice, and (b) what to do after something has our attention. In education we carefully construct information environments to channel attention and encourage learning. But organized, deliberately selected and constructed information sequences are expensive. It takes energy, resources, effort and money to provide the right information at the right time with the right questions being asked.

I propose that the curriculum has always been constrained by the cost of information. A printed page of words has about 10,000 bits of information and costs about 3¢. A colored slide has about 250,000 bits of information and costs about 50¢. A full page printed color picture costs about 10¢. A half-hour color motion picture has about 100,000,000 bits of information and costs about $700. Organized real-world environments such as chemistry labs, machine shops and field trips are much richer in the amount of information availble, but also much more expensive. I hear that colleges are dropping laboratories because of their cost.

The above was introduced to suggest that education, constrained by economics, has tried to maximize its benefits from its information purchases within a limited budget. Words, symbols and line drawings are both cheap (in information and in monetary terms) and powerful. They help us to organize the sea of free information we float in. As a result the curriculum has tended to emphasize what can be taught with words, symbols and line drawings. The difficulty that has arisen is the following: words and symbols are good for teaching descriptive and declarative knowledge and not so good for teaching complex procedural skills such as piloting, laboratory procedures, medical skills, equipment troubleshooting and repair skills, craft skills, etc. But there are exceptions. We can use words and symbols to teach procedures with words and symbols. We can teach mathematics because it is a symbolic subject, and we can teach some introductory science with words, symbols and line drawings (but not very well).

So, in mass education we have taught students *about* things. We have tended to teach "what" rather than "how." When we finally are faced with the need for complex, information-rich environments to teach procedural skills, we, in the last stages of formal education, put students in an apprenticeship mode, in the laboratory, the shop, the field and the workplace. Since this is very expensive (over $100,000 per year for a pilot, about $50,000 per year for a graduate electrical engineer and similar amounts for doctors), it is reserved for those who have survived the culling process of education. When budgets get tight, there is pressure to revert to that which can be taught by words and symbols.

The Videodisc

The videodisc, if it becomes a mass educational medium, can change this. Many complex procedural skills need a lot of information that cannot be evoked by common experience or by analogy with common experience. As noted above, for many skills the student needs an information-rich mode of skilled performance. The videodisc can provide such models of skilled performance at the extremely low cost of about .025¢ per full color picture or about $25 for an hour of television. If we now wed the image capacity of the videodisc with the logical power of the microcomputer, we can begin to teach by simulating complex, information-rich environments.

The significance of all this is that with the computer plus videodisc, the intelligent videodisc, we can imagine systematically bringing procedural skills into the introductory college curriculum and creating a more powerful mixture of knowing what (knowing about) and knowing how. While simulation via the intelligent videodisc is not as information rich (things don't smell, burn, go wrong in unexpected ways) as the real thing, it certainly can increase the quality of education as long as we don't confuse the simulation for the real thing — but this has always been a problem, even with words, or perhaps, especially with words. (The map is not the territory.)

Computer Memory, Program Sophistication and Computer Intelligence

Another aspect of the economics of information is the cost of computer core memory. What we can do with computers is limited by the amount of core memory that we can easily buy. Small memory size limits computer intelligence. I have come to the conclusion that one of the reasons that computer-based instruction has not captured the allegiance of more educators is that our computer-based instructional programs are not sufficiently rich. The videodisc partially compensates for limited memory by giving us a huge supply of images. However, those images are relatively fixed and inflexible. If the core memory of computers were equal to that of a videodisc, we could do many exciting things that cannot be done with videodiscs. At the present time, a husky set of word processor programs can require half a million bits of memory. Microcomputers with this amount of memory are not yet affordable for instruction. But since the power of computers is doubling every two years, we can anticipate a steady increase in the quality of the programs that are available.

It is important to appreciate what gradual increases in computer intelligence will mean. Little by little, like an advanced word processor program of today, our instructional and research programs will become more interesting objects. The complexity of their responses to our initiatives will grow. They will say things like, "Gee, are you sure you meant to type 'br ad'? Perhaps it was a Freudian slip and you meant to say 'board'."

While the artificial intelligence people are doing the basic research for the years down the road, computer intelligence in a more mundane sense is growing rapidly as a result of powerful economic forces. Billions of dollars per year are involved in secretarial skills, the design of drugs, routine industrial jobs, banking operations, medical diagnosis, etc. A small increase in computer

sophistication can mean great increases in productivity. The question is, how will higher education interact with this development? Will we help to determine the course? Will we even stand ready to capitalize on the advances made for other fields? Or will we, with some exceptions, become increasingly isolated from these powerful developments?

Cognitive Science

Another reason that computer-based instruction does not perform as well as the technologists predict is that we do not yet know very much about human learning and thought. Our schools and colleges have gradually evolved a tradition for using our resources and our intuitive sense of human learning. To design new environments without many of the familiar elements of campus life, we need a better understanding of: (a) emotional factors that influence our interest; (b) attention; (c) the way different forms of knowledge are best represented for learning; (d) how knowledge is represented in the mind; and (e) how we draw on our learning when we have a problem, etc. Without this knowledge our technological designs are liable to have serious gaps.

Organizational Structure

It seems a truism that organizational structure should reflect the dominant technology used. An organizational structure should help people to be productive and creative with the technologies being used. A large accelerator imposes the need for a different organizational structure than a collection of one-scientist laboratories. Similarly, if we believe or become convinced that the computer will be the dominant intellectual tool for research and learning, we should reorganize our colleges in order to help faculty and students gain access to this new medium for manipulating and expressing ideas.

Thus, to make progress with the new information technologies, we need (a) more powerful computers; (b) more complex, interesting, and sophisticated programs; (c) the widespread use of intelligent videodiscs; (d) greater understanding of human learning; and (e) reorganization of our colleges to help us integrate these technologies into the intellectual fabric of our colleges.

The State of New Technologies: Word Processors and Optical Character Readers

If I had to select the technologies that have the greatest and least uncertain importance for scholarly effort, I would pick the word processor and the optical character reader. The word processor will help us to accelerate the formation, expression and transmission of ideas. This seems to be clear from my own experience and those of others. With new mechanisms of teaching, of criticism and for sorting sense from nonsense, the word processor may even help improve the quality of ideas, but I have less evidence on that score.

The optical character reader is a vital component to the word processor. Where the word processor helps us to generate scholarly documents, the optical character reader will help us to retrieve and make better use of the ideas of others. Today, optical character readers can transform almost any printed material into computer code. This means that (in addition to being a tremendous breakthrough for blind people) our libraries can be put into computer files without millions of hours of secretarial time being spent. Once encoded in computer code on some kind of storage material (e.g., high density magnetic discs) we can begin to have computer algorithms that will greatly speed up the search for relevant references, related ideas, key connections with the work of other scholars, etc. People will be able to link up with, comment upon and modify existing work for their own purposes.[3]

Scholarship depends on the cumulative effect of building upon the ideas and work of others. Yet our current methods of retrieving the relevant ideas of others is limited by the bottleneck of current paper-oriented library research methods. With the huge number of scholars active today, we need an information science using computer technology to capitalize on their efforts — to minimize the reinvention of past ideas and relationships. While not yet cheap, the optical character reader is a keystone of my hopes for a technology of information science.

Speech Synthesis and Speech Recognition

Speech synthesis is already developed and available at low cost. Speech recognition by computers, on the other hand, is both expensive and fairly rudimentary. What is the contribution that they can make to colleges? Pat Suppes has argued that even with Stanford students, a significant fraction prefer to listen to instruction in logic rather than read. The fact that one can listen while doing other necessary tasks is certainly a compelling if mundane justification for speech synthesis. In foreign language instruction, it would be a significant advantage to have speech synthesis as part of a computer-based course.

None of the uses of speech synthesis are as exciting as the possible uses of speech recognition. Many times I have felt that in conversation certain ideas come alive, are uniquely well expressed but die because the notes or the recollections do not capture the essence of what was said. Low cost computer speech recognition means that conversations, lectures, etc. can immediately be thrown on the computer screen, be edited while the ideas are fresh and be used as a memory file with links to other conversations or other works.

Communication Networks

The technology for networks of computers linked to other computers and vast information banks is currently available at a tolerable fraction of a person's daily income. Many people are linked through networks that are subsidized. Significant numbers of people are subscribing to data banks such as The Source without any subsidy. These data bank networks can and do supply any information, particularly timely information that has value only while it is fresh (e.g., stock market prices, new patents, events taking place in an area, driving conditions, etc.), that people find valuable. The ways that computer networks can assist scholarly work include the search for patterns in fast-moving daily events, the searching of large archives of computer stored data and access to specialized and recent works that only reside in the local memories of other people and other computers. For example, one of the most popular uses of the network of PLATO system users was a set of files for people with special interests. If one wanted an answer to an environmental question or a question about high fidelity, the word was sent out over the network and soon a col-

lection of answers, opinions, and experiences began to collect. Networks give an affordable medium and a cumulative memory to any number of invisible colleges. Once the information is available on the network it is potentially visible to others who are interested.

Fiberoptics, and possibly satellite technology, will almost certainly mean that low cost networks could be well within the reach of private subscription. Whether computer network participation becomes as ubiquitous as ownership of telephones depends upon the regulations that are worked out by government and the communications industry. College administrators and faculty should participate in the discussions that are continually taking place on this issue.

The Wave of Future Technological Developments: The Five-Year Forecast

The difficulty with predicting future developments that will take place comes from the way technological developments interact with each other to produce surprising combinations, the way that social, government and business decisions affect which developments are favored; and the way emerging technologies change our environment and our psychological horizons in unanticipated ways. Thus our predictions are a real test of our integrated world view -- and we find our model of the world is usually not very accurate or complete when put to the test of technological forecasting.

On the other hand, we have no choice. Whether implicitly or explicitly, we make current decisions on the basis of our expectations about the future. The following express some of my expectations.

Hardware. Within five years the two-thousand-dollar computer will be sufficiently impressive to serve as a powerful word processor, a node of a communications network and a tool for a majority of scholarly or student purposes. A high quality printer will cost an additional thousand dollars. Thus the basic investment is about $3,000. If we assume a three-year life for such an instrument, this means that everyone needs a thousand dollars a year to participate. Sharing cuts costs and decreases the benefits to a degree.

Specific advances are likely and will be important. The videodisc will be in fairly wide use in industry, the armed forces, medicine and with the handicapped. It will not be in wide use by college students because of the inertia of our commitment to words and symbols and our failure to invest in the development of instructional and research-oriented discs. The digital videodisc will be refined for special purposes and will represent the beginning of the ability to put sizable libraries (say about 40,000 volumes) in portable form at the disposal of most faculty and possibly most students. At some point (possibly within five years) the potential cost savings will become sufficiently apparent and publishers will begin to offer videodisc libraries for sale.

Electronic publishing. Publication via stored (e.g., videodiscs or magnetic discs) material or via transmitted material (electronic mail, computer networks, videotex, etc.) will become sufficiently cheap to compete directly with paper publication. The regulated cost of telecommunication will determine both the rate and direction of this development.

Libraries will begin to put all their holdings on-line using optical character readers. This will not only aid scholarly search but also eliminate the present erosion of holdings by theft, vandalism, etc.

The Dynabook. High resolution, large (at least 5" diagonal) flat black and white screens will make the computer sufficiently small and light to be truly portable. Speech synthesis will be in widespread use. Speech recognition, driven by the potential of replacing our present army of typists, will be used commercially and will begin to be used by faculty.

Computer memories. Computer memories for a given amount of money will grow by a factor of about five or six. As these larger memories become standard and as the number of faculty, student, and personal computers grows, there will arise an expanded market for software publication that is already being actively pursued. Within five years, sophisticated programs for word processors and computer-aided design and management of all kinds (e.g., financial management) will begin to show such power combined with ease of use that they will be sold by the thousands and hundreds of thousands. Where these sophisticated programs are used, they will affect every aspect of university life. There will be programs that permit the average student or faculty person to write a wide range of programs with no knowledge of computer languages. The program will be determined by English language answers to a set of questions generated by the computer. The pressure to learn a computer language will be eased by the development of this system of generating custom-made programs.

Software and hardware. Within five years computer hardware will be sufficiently powerful to accelerate change due to the number of things that will be possible by writing new programs and because (as mentioned above) the computer will help to write good programs. Thus we will no longer have to wait for the introduction of new hardware to begin to realize some of the ways that the computer can serve as a tool of the intellect. We will begin to experience a new effect on planning, management and research.

Central facilities. Before pieces of equipment such as videodiscs, optical character readers, voice recognition equipment, image processors, etc. become cheap enough and portable enough to be owned by most faculty and students, they will, in certain schools, be available in centralized campus facilities.

Students. In five years there will be a definite pressure for every incoming college student to arrive on campus with a personal computer. The student will bring or shortly acquire a collection of fairly advanced word processing, speech synthesis and records processing programs such as advanced forms of Visicalc that can be used to register for classes, accept a class schedule, keep a calendar of assignments, keep notes, etc.

Faculty. Most young faculty who are serious about research will have their own computer either at the office, at home, or both.

Important Topics for Future Discussion

I would like to nominate the following topics or issues that I believe deserve policy attention:

- *Money and other resources.* How can we invest in the new technologies as a form of capital investment? Who benefits and who should pay?
- *Talent.* How can we develop the curriculum and support for the professionals who will develop the college-oriented instructional materials and sys-

tems that are possible and desirable?

- *Reorganization.* How should the university be reorganized in order to help faculty and students use the new technologies effectively?
- *Rules of access.* How should access to the new facilities be managed? Should these services be open on a demand basis like the library, or should there be some other arrangement?
- *The pace of change.* How can we deal with change when the rate of change is increasing and the resulting changes are ever more surprising?[6]
- *Computer science as a college subject.* How can we keep an adequate supply of faculty so that the flow of computer science talent is not choked off? How can we keep the need for computer professionals and for other specialties from distorting the purpose and nature of the university?
- *Government and others.* How can we interact with outside agencies to serve them with our knowledge and participate in their decisions that affect the quality of university life?

Initiatives and Recommendations

Usually I am asked what I would offer as solutions to the above issues. I try to avoid an answer for the following reasons. "Things as they are" do not arise by accident but as a result of social, economic and other forces as they interact with human problem solving ingenuity. Thus the solutions should come from working administrators and not from someone who is not faced with the history and current state of the individual institution. Another reason is that a response to the challenge of the computer is a vast undertaking that will require whole arrays of social inventions as solutions to myriad problems and opportunities. Whenever I have been an administrator I tried to contribute to solutions and to think of the kinds of social inventions needed. On the basis of that experience, I can offer the following general recommendations:

1. Create an Office of Experimental Initiatives. Make sure that the office has access to a sizable and flexible budget. To give a unit of the kind I imagine the budgetary flexibility it would need so that it can do the job I imagine without becoming a Parkinsonian dinosaur would in itself be a major social invention. I imagine a kind of laboratory to gain the first-hand experience and knowledge needed for major decisions by the administration. Sometimes the needed knowledge can be gained from reports, trips to other places, demonstrations or consultants. But, from my experience there is no substitute for some first-hand information-rich experience *before* a decision is made. The kinds of activities of this office would include implementing some of the following recommendations.
2. Conduct trials of new instructional materials (courseware), new routines, software and procedures that have significance for scholarly work.
3. Conduct competitions for major new equipment and service purchases.
4. Bring in consultants, arrange visits to interesting experiments elsewhere, request, purchase, collect and distribute information.
5. Deliver talks and reports on all kinds of new equipment, software and managerial approaches on the horizon so that the faculty and administration begin to think about them *before* a decision is called for.
6. Create new organizational units on a trial or pilot basis prior to putting them to the faculty for a decision or prior to installation on a permanent basis by administrative decision.
7. Convene a permanent staff committee that might be called the Committee on Future Technological Initiatives. The charge to this committee would be to keep up to date on advances in technology that have implications for research and instruction.
8. Participate in EDUCOM. Represent the university, the faculty and the academic community with Congress, the Federal and State administrations, the alumni and the public. From my experience this is one of the areas that needs the most work. The academic community in this country simply does not have the clout that its importance to our future warrants.
9. Prepare proposals for both internal reallocation of resources and for external resources to start new initiatives that capitalize on the new technologies.

In my experience, when something is to be done with a high degree of certainty, it must become the major responsibility of a single person who has some authority, a lot of responsibility, respect of the administration and faculty and some resources to allocate. This is a major reason for the proposal of the office discussed above. The amount of resources need not be great if the other conditions are met. In particular, the power barons of the university community must be at least sympathetic and at best enthusiastic about this person and his/her mission. The head of the "Office of Technological Initiatives" should have a title, access to the President or Chancellor and freedom of communication through meetings, reports, memos, etc. There should be some procedure that requires the administration to give a public answer (and perhaps a requirement to organize a faculty vote) to any recommendation presented by the head of the office with the approval of the Committee on New Technological Initiatives. I hope you take the problem, if not my comments, seriously. The future depends upon it.

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STAYING IN CHARGE

A BRIEFING FOR IMPROVING INFORMATION SYSTEMS CONTROL

PRESENTED BY: MR. JOEL B. URMAN
SYSTEMS SECURITY CONSULTANT
IBM CORPORATION

EDUCOM ANNUAL 1981 CONFERENCE

KANSAS CITY, MISSOURI

Today, people and machines are in direct, continuous partnership, forming an information processing system that can be highly effective and productive, but involving certain risks and requiring adequate controls.

More people are directly involved now in information processing because new hardware and programming technologies have moved the power of processing information directly into the classroom, laboratory, and the executive office.

Your information processing system has become a critical support system for your institution. You depend on it. You have to be sure that, based on current controls, your system is doing what you expect it to do.

That's why it's time to reassess your information processing system...the people and the machines, and the communications links...to insure that you really are in control. In the process you may discover some ways that your college can function even more effectively.

To put the subject in perspective, we'll examine the changing relationship between people and machines in processing information.

The barriers between the computer and the clerk, student, administrator, and even the executive, are fast disappearing. This closer relationship, combined with the tremendous growth and widening scope of information processing applications, has prompted administrators and educators to re-examine some of their assumptions about information processing controls with questions like these:

"Must I become a computer expert to run my office today?"

"Can additional controls really improve the productivity of our information system or merely create more red tape?"

"Have I handed over too much authority to the applications and systems experts?"

"Suppose my auditors don't understand the system. How can they test it for compliance? How can they access the adequacy of the controls?"

"Can we really protect our system and its information?"

"Do we have adequate controls to meet new legislative and regulatory requirements?"

"Can we protect ourselves against computer fraud and misuse?"

"Just who is in charge here?"

Productivity, liability, security, legislation, regulation, privacy, audit, control are subjects you hear about, read about in memos and business journals, and discuss increasingly. Your information processing system, people and machines, is at the center of many of these discussions. It is not just part of the problem, however. It can be a major contributor to the solution.

There are some topics related to systems controls that we're not going to cover because they are so specific to each individual. Questions like: "What are the best ways to hire, train and manage people to improve security?" You can see how much that depends on your own personnel policies, the job market and your whole program of labor and government relations.

Or - "How do I deal with back-up and contingency planning?" Here your location, available alternatives and your own cost objectives will make dramatic differences.

To find out where you stand, look at the basics first: Are the doors of your computer rooms, files and libraries open? Can anyone have unlimited access to your desks and terminals and data bases? Are there any restrictions on who is authorized to submit, use, modify and store information, or on who owns individual data files and elements? All of these are potential action areas for improving control. These examples are typical of the day-to-day control problems we all experience. They have the potential, however, of being very dangerous.

While it is tempting to look for exotic solutions to complex control problems, much of what you need is just good sensible management techniques applied to information handling.

Because some of these solutions are so obvious, many of them never get done or are even considered. They are usually a combination of protection and detection measures, since, in most cases, the costs of complete before-the-fact protection can be prohibitive. But a good system of after-the-fact detection also can be a powerful deterrent, especially if it is well-publicized and consistently implemented.

It is important, too, early in your analysis to conduct a high-level review of how information actually flows through your organization.

Since the information system itself is a partnership of people and automatic processes, the control system must encompass both elements. Don't expect either manual procedures or automatic functions alone to do the job. They must be designed to work together as a whole.

Begin with a review of how your controls were developed, who is responsible and who is affected. You may discover some interesting facts. For example, your system may lack continuity of control.

While the information itself may be flowing freely among people and machines, the authorization and control schemes, audit trails and security mechanisms may be operating in totally unrelated patterns, following neither the information nor the transactions, but only small portions of each flow.

Obviously, college officers can't follow all the pieces of information and transactions to see where they go. However, a quick survey of your administrative, faculty and information service staff will help. Focus especially on how they see information ownership, security responsibility and usage authorization. Sample the movement and usage of some key forms of information.

As more and more organizations move toward the use of data base management systems, whether consolidated in one site or distributed over a number of locations, the disciplines associated with these data base systems are helping to determine data ownership and usage. They are also bringing these relationships and discontinuities to the surface.

Some European privacy legislators have separated these relationships into these five categories:

- The information subject. This may be an individual, organization or thing.

- The information originator. This is at what point or points and through whom a particular item of information first enters the system.

- The information caretaker. Frequently, but not always, this is the internal information systems organization.

- The information owner. This is usually an operating or staff organization and sometimes very difficult to identify especially if data is shared. This is the category from which the priorities, rules and conditions of information usage should come.

- The end-user who benefits. This, in many cases, may be none of the above.

A high-level profile, showing how all types of information - academic, financial, administrative, personnel - move through your institution probably will reveal more about how your college really works than most organization charts. It also will point out many of the critical stress points - manual and automated - where information can go astray.

You may be surprised at the number of different routes and different forms a single piece of information may take during its life cycle. Each stopping point represents an opportunity for profitable use and/or a position of vulnerability.

Our three elements of system control are security, auditability and systems management.

Let's start with security: How can you protect information, programs and systems resources, such as terminals, computers and certain types of services from unauthorized modification, destruction, disclosure and usage?

Our studies have indicated that the primary security threat is the unintentional error or omission by authorized individuals.

These are followed in frequency and scope of damage by: dishonest users, fire, disgruntled users, water and finally external attack. As you can see, authorized individuals are a more likely source of security breach than the outsider simply because they have access to the information resources. So you need a process of checks and balances through the entire system. For example, if you can manage it, application and systems programmers should not test their own work. Programmers should not operate equipment and operators should not program. Critical data entry should be verified by a second party, a separate program, or both.

While errors and omissions occur most often, and in the aggregate do the most damage, you can't ignore other possibilities. Certainly, one single highly destructive attack could be devastating.

But remember our principle of looking at basics. Since your resources have some limit, you can't guard against every eventuality, nor would it be cost-effective to try. So, first stress some of the basics like identification, authorization, enforcement and journaling of use to substantially reduce the high probability items such as commonplace but expensive errors. Enforcement of accounting and editing controls will help to reduce omission.

Then you can decide how elaborate a set of protective measures you want to add to ward off forced entry, electronic eavesdropping, unauthorized access to the system, holding files for ransom, bombings and other forms of real but less likely threats.

There are three major tools for dealing with security in an information system: access control, integrity, and encryption.

Access control involves physical barriers such as locks on computer room doors, tape and disk libraries, terminals, consoles and printers. It also means system barriers built into programming and manual procedures which will release a transaction, a data element, or a document only on proper authorization.

Computing systems can be made very secure if they have properly structured data bases and an access control program requiring a password, identification and authorization before allowing usage. In addition, an accurate and comprehensive system that describes the data, the user and approved circumstances of use is necessary not only for access control but to assist auditors as well.

You need two other important elements; a well-thought-out authorization plan and strictly enforced discipline, which is where you and your executive team come in. Protective techniques only work if they are consistently, clearly and conscientiously applied.

There are parallels to each of these computer techniques in manual procedures and they, too, must be strictly enforced. There is little point in turning a computer room into a fortress if the same information is freely spread around in clerical and operating areas. However, even more fundamental to access control is an understanding of how authorization should be assigned.

This is why we suggest beginning with an assessment of your information flow. You should determine not just who can have the information, but when and under what circumstances; who has priority on usage, who maintains and controls the record of usage and, perhaps most important, who can read, initiate, modify and destroy information.

Locks are useless if everyone has a key.

System integrity supports access control and prevents accidents. System integrity means that you can only use the processes or paths through a program, device, computer or telecommunications system that have been explicitly intended by the designers and implementers. This stringent control is necessary to avoid deliberate backdoor entry or accidental side-effects in any process. In a complex computer system with many interconnections, and with interrelated programming systems handling simultaneous and unrelated transactions, integrity is absolutely essential.

Integrity is more difficult to provide and assure as the system becomes more complex. However, a special effort has been made to provide greater system integrity in such recent equipment and operating systems as IBM's 8100, developed for distributed processing, and the company's operating system for large, high-speed processors, MVS (Multiple Virtual Storage).

Encryption is a technique to protect the information that moves outside of your access control systems, principally over telecommunications lines or on portable media such as magnetic disk or tape. There are a number of techniques for encryption. IBM contributed the encryption algorithm that has become the Federal Data Encryption Standard in the United States and has developed products using this algorithm.

No practical encryption system is totally unbreakable. What is important is that the effort required to break the encrypted information must far exceed the value of the information itself. That is why even though the same basic algorithm may be used, there are various levels and techniques for encryption available to protect different levels of information value.

Finally, there is no such thing as total security. While this point seems obvious, the pursuit of total or absolute security often has been the cause of frustration, misspent resources and, in some cases, total abandonment of projects. Realism is key.

An effective security system must be tailored to an objective plan based on your organization's requirements, capabilities and available facilities if it is going to work.

A necessary ingredient in the establishment of a smooth-flowing information system is your own ability to monitor or audit it - to verify its accuracy, insure its adequacy to serve your goals, and evaluate its results. Auditability is the single most powerful tool you have to insure the proper use of your information system - but it's not just for auditors. Executive highlight reports on information system audits should go directly to your desk.

In addition to the traditional accounting controls, any system requires complete, accurate and up-to-date documentation of all manual or automatic information processes within it. That same documentation can serve another extremely important purpose: the management of change.

Consider the addition of new offerings, a new campus, different contracts, or new legislation. The speed and effectiveness with which your overall information system can respond directly affects the success or failure of these management steps. Adequate documentation is both an operational necessity as well as a primary aid to the auditor.

Software that will detect changes in programming, data definitions and data content is available to assist the auditor and systems designer. For example, there are application and systems analysis programs that will provide an integrated picture of the diverse actions and changes taking place within the system. With these capabilities, your people can review and understand the relationships among the events that occur in the normal flow of information.

Today, the externally and internally auditable system is no longer a luxury. There has been an increasing amount of legislative and regulatory activity on computer-related crime, and the protection of privacy at Federal, state and local levels.

These are some of the elements that make a system auditable.

- Edit capabilities
- Journaling and logging
- Verification and comparison
- Integrity
- Authorization verification
- Process documentation
- Reports

Let's take a moment to consider the role of the systems auditor. Auditors should influence the design of any control system and procedures for managing the flow of information. Many of the auditing functions we are describing are actually performed by operating departments as well as systems and computer staffs. An increasing number of organizations, including IBM, have established systems assurance and quality control groups which are part of the operating and systems organizations. They develop control standards, participate in design and, in general, inject the control philosophy into the information handling process. They must be organized, however, to insure independence and objectivity.

Auditor participation in the design of procedures can also present a dilemma. Can an auditor maintain objectivity when making recommendations that affect system or application design decisions?

You can resolve this problem by striking a balance between auditor involvement and independence. Primarily, the auditor should stipulate the requirements for documentation control and system access. This is critical to the auditing function, and may require some additional DP training for many internal auditors. The auditor must also participate heavily in developing audit trails which will document personal responsibility for actions taken and trace secondary effects.

The auditor should then serve in a review capacity on how those requirements are met. In this way, auditors can be objective and still contribute to effective procedures and control.

System management and accounting controls are vital for the efficient processing and overall productivity of your system. The following is a general checklist of the kinds of controls your systems personnel should include in their planning.

Data entry and output controls. Are all items in and out accounted for? Are all changes to input and output accounted for at each major step in the process?

Program preparation, test and submission controls, as well as modification controls. Are these functions separated so that programmers are not acting as both testers and judges of their own work?

Usage and operations accounting for internal billing and performance measurement control. Who is using the system? What processes in the system are getting the heaviest usage? You get a clear picture of where real information workloads come from through this statistical base.

Library and intermediate storage controls. Is your repository of data...disk, tape and cartridge library...secure and auditable? Is there an effective inventory management system?

Failure, recovery and restart controls. These are often overlooked. They help insure that nothing is lost and that no unauthorized change occurs during a failure, recovery and restart...periods when your system can be especially vulnerable. These apply both to disaster contingency planning and to the more typical operational failure.

Network traffic controls. Did the message arrive on time, intact, at its destination and only its destination?

The Systems Auditability and Control Study, sponsored by the Institute of Internal Auditors, was funded by IBM, and conducted by SRI International. It has proposed a list of management actions to help guide the development of information systems that are adequately controlled and auditable. We have modified this list to include security and installation management.

- Insure that all managers and department heads realize the importance of internal audit and security controls in information processing.

- Require the development of detailed control guidelines.

- Develop a clear and enforceable authorization plan and take the appropriate access control measures - physical and system - to implement this scheme.

- Clearly define the responsibilities and working relationships among users, internal auditors and the information processing department in the development and maintenance of information systems.

- Conduct a risk assessment program beginning with the most fundamental and prevalent problems and working outward to the less likely event.

- Encourage the development of new data processing control techniques to insure a more reliable and secure information system for your specific environment.

- Insure adequate pre- and post-installation control, verification and testing of automated information systems.

- Insure that the security, audit and systems management functions are assessed by management.

More and more information systems are using interrelated or consolidated data bases each day, and overall control of data base operation has become vital to efficient system operation.

Data base administration involves considerable detail such as maintaining unique names for each data element and insuring that all users understand the size, meaning and characteristics of the data elements. But it also involves the fundamental policy and management questions we've discussed.

Who in the organization "owns" the data? Who are the principal users? Who are the data suppliers?

And the interrelationships of owners, users and suppliers raise further questions. Who may inquire into the data base? Who may modify the data? Under what circumstances? When? Who determines the useful life of the data?

Obviously, data base administration is not merely a clerical function, nor is it a function restricted to systems organizations. Owners of the data base are involved as are users, auditors and security personnel. They must all participate in the data base administration process. How your data base is managed is key to your entire information flow.

There was a time, not too long ago, when the limitations of computing equipment, programming techniques, available skills and the press of applications installation all conspired to make controls the very last priority.

Now, equipment is much faster and more powerful and prices are much lower. There are more powerful programming languages and subsystems available as well as more skills and facilities for better systems design and development.

However, as we've seen, new interactive applications have increased dramatically both in number and complexity. And the old pressures to "get on the air, regardless" are still there.

So, in many organizations, executive direction is still required to reprioritize the importance of controls in the information handling process. Specifically, what should you do? The first step is to insure that individual responsibilities for control are clearly assigned in ways that can be accomplished and measured. For security, auditability and control to be truly effective, each manager and employee must know what they must protect against, what risks are acceptable, how to report variances and what corrective actions to take.

To do this, you must assess which situations require and respond to protective measures, which situations are adequately covered by detection alone where best to direct your resources.

Back-up and recovery plans should involve both data processing and using departments. The feasibility of these plans should be reviewed and assessed by all involved parties.

Finally, and most important, you must measure performance and take prompt corrective action when necessary. Like all other management functions, a good program of information system control is not an event but an ongoing process - and it all begins with the person in charge.